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DETERMINATION OF IRON.

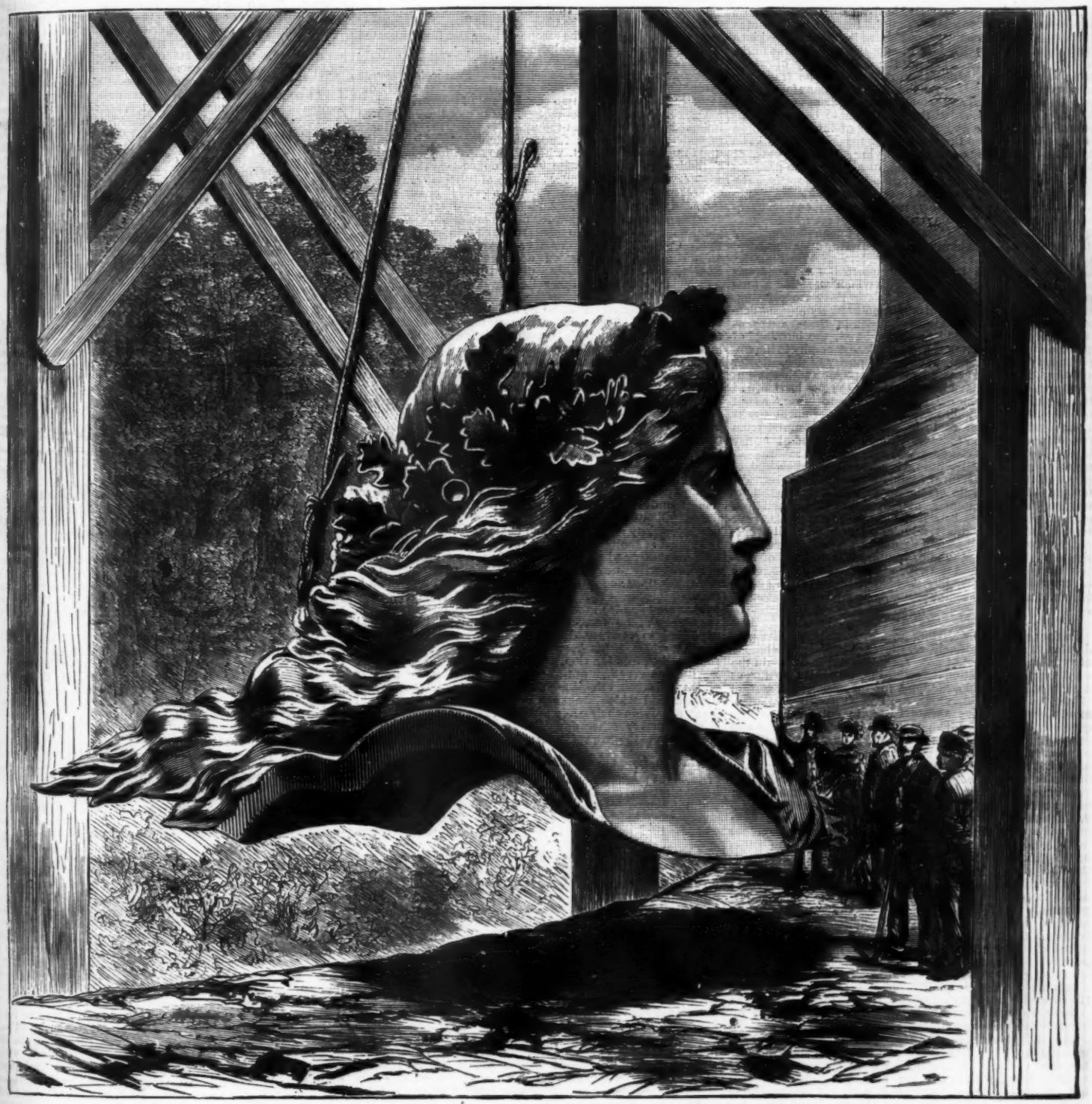
By J. KRUTWIG AND ALB. COCHETEUX.

THE injurious influence of hydrochloric acid in the titration of solutions containing ferrous salts by means of Margueritte's process was first pointed out in 1881 by Lowen-that and Lenssen. The importance of the method led Fresenius and others to search for means of obviating the disturbing action of hydrochloric acid. Some time ago there appeared in the *Berichte* a memoir on the same subject by Clemens Zimmermann. He recommended an addition of manganese sulphate to the hydrochloric solution. The authors have tried this method in many determinations of iron ores, and obtained accurate results, so that they can recommend the use of manganese sulphate. It seemed remarkable, however, that determinations of iron which they had formerly made had likewise given figures analytically correct. They believe that the cause of this was that they dissolved the iron ore in the smallest possible quantity of hydrochloric acid (10 c.c. to 0·1 grm. of ore), adding then 400 c.c. water and about 30 c.c. sulphuric acid. Special experiments seem to justify this supposition. The use of sulphuric acid keeps down the discrepancies in the results, so that there is no objection to the use of Margueritte's process in presence of hydrochloric acid if the following precautions are observed:

1. If possible, dissolve the ore in very little sulphuric acid.
2. Reduce by means of zinc in the hydrochloric solution.
3. Add a quantity of sulphuric acid twice as great as that of the hydrochloric acid.
4. Dilute the solution to about 300 c.c.
5. Use dilute permanganate in titration.—*Berichte Deutsch. Chem. Gesell.*

THE GERMAN NATIONAL MONUMENT ON THE NIEDERWALD, OPPOSITE BINGEN ON THE RHINE.

FOR the last ten years a gigantic monument, in commemoration of the union of the German States caused by the Franco-German war, has been in course of erection on the Niederwald, opposite Bingen on the Rhine. The pedestal was finished a few years ago, and lately the castings have been completed in the well-known bronze foundry of Mr. Von Miller in Munich.



THE GERMANIA STATUE ON THE NIEDERWALD AT BINGEN.—RAISING THE HEAD OF THE STATUE.

The main features of the monument are a colossal statue of Germania, and two smaller statues representing Peace and War, all modeled by Prof. Schilling. The statue of Germania was cast in pieces, which were transported separately to Ruedesheim. The parts of the statue were transported by rail from Munich to Rosengarten, from there to

Ruedesheim on flat boats, and were then carted up the hill to the pedestal on wagons, each drawn by twelve horses, which were assisted by about thirty laborers who acted as pushers. The lower part of the statue, which is the heaviest, consists of the throne and the drapery on the lower limbs of the statue. This part weighs about nine tons.

A large scaffolding seven stories high was built over the pedestal, and on top of the scaffolding a movable crane was placed on tracks. The base part of the statue was raised on the 16th of July, and the head of the statue was secured on the body on the 28th. Great difficulty was experienced in fastening the arm carrying the crown to the statue. One of Mr. Von Miller's workmen climbed into the arm and was raised with the same, and while in this gigantic arm he bolted it to the body; and then by means of a rope he was drawn up through the arm and out of the wrist opening of the same.

One of the annexed cuts, taken from the *Illustrirte Zeitung*, shows the scaffolding for raising parts of the statue, the lower parts being partly raised; and the other cut represents the head of the statue raised a short distance above the ground.

EXPLOSIVE COMPOUNDS.

In his presidential address, delivered at the recent second annual meeting of the Society of Chemical Industry, Sir Frederick Abel made the following remarks on the subject of explosives:

It is one of the most remarkable features connected with the history of gunpowder that until the last quarter of a century no radical change should have been introduced into the manufacture and modes of applying this, the first known practically useful agent, the early history of which remains enveloped in mystery or is based upon traditions of uncertain character, and the extensive manufacture of which long preceded any scientific knowledge as to the *rationale* of its action, and of the conditions to be fulfilled as regards proportions and incorporation of ingredients, and the mechanical condition of the resulting mixture. The methods of preparing and of purifying the ingredients, of blending these, and of converting the mixture into particles or grains of suitable size to furnish a rapid or slow burning powder of sufficient hardness to resist transport and rough usage, have undergone a few modifications as our mechanical resources have become developed; but even at the present day some of the earlier methods of manufacture may be found in use at extensive Continental powder factories. I have even heard experienced directors of such factories give the preference in some respects to the old stamping mortars over the incorporating mills which were for a long period used only in England. Similarly there are pressing, and corning or granulating arrangements of very ancient date still in use in many works, and regarded in those places as thoroughly efficient. On the other hand, the burning of charcoal in mounds or pits has given place generally to the employment of retorts, and the degree of purity of the saltpeter and the sulphur used has, of course, kept pace with the improvements which have been effected in the production and refining of those materials, although, up to a very recent period, a strong prejudice existed at our government works against saltpeter known to have been manufactured from the sodium salt, even though its equality in point of purity to the best Indian saltpeter was admitted. The sort of mystery which, until within very few years, appeared to surround the manufacture of gunpowder, and the great deference paid to the rule of thumb experience possessed by workmen of long standing, and by successive generations of men whose forefathers had been powder makers, have contributed to maintain a reluctance to meddle with time-honored arrangements and regulations which have been applied with success to the production of a material of fairly uniform quality, and have been instrumental in rendering it very difficult to introduce decided changes in the system of manufacture pursued at particular gunpowder works.

BLASTING POWDERS.

So far as mining or blasting powder is concerned, its production at a comparatively very low price, and the absence of any standard or test of power, contributed to maintain the manufacture in a stationary condition, except in so far as any expedients could be adopted for increasing the margin of profit of the manufacturer, until, about twelve years ago, more violent explosive agents began to enter into serious competition with it. The attention which dynamite and gun-cotton had already excited at about that time, and the recognition of the fact that blasting powder might be economically and otherwise advantageously replaced in many kinds of mining work by explosive agents more rapid and more violent in their action, led to the invention or resuscitation of a great variety of explosive mixtures for which special advantages were claimed. The greater number of these have enjoyed a very brief and inglorious existence. On the other hand, some preparations of nitro-glycerine and gun-cotton have become so firmly established as valuable blasting agents that the manufacture of blasting powder have long since been taught that the days are passed when powder could maintain its supreme position as the only, or even the most, practically useful explosive agent for industrial purposes, and that cheapness no longer contributes an all important feature in the advantages to be claimed for it. The miner has now become critical in regard to the quality of blasting powder supplied to him, and this has not only led to the bestowal of greater care upon the incorporation of the ingredients, and upon their quality, but has also brought about the extensive introduction of two or three forms of blasting powder which are very decided improvements upon the ordinary black powder sold under that name.

One of these is the extra strong mining powder (E.S.M.) manufactured by Curtis & Harvey, which, in point of care bestowed upon its introduction, has much resemblance to artillery gunpowder; and the compressed powder first brought out by Messrs. Davey & Watson and manufactured by Messrs. Hall & Son, but now also produced by other manufacturers, which is at present extensively used in mining districts, and with results very satisfactory as compared with those furnished by the old blasting powder. The perforated cylindrical form of charge, of dimensions suitable for different-sized bore-holes, was first applied, in connection with compressed gun-cotton, about sixteen years ago, and was found to present advantages independent of the nature of the explosive agent. The compact cylindrical masses of the material are convenient to pack, transport, and handle, while the conversion of the substance into a homogeneous mass of considerable density, solid throughout, except that a fuse hole passes through the center, considerably reduces the space which it occupies in a blast-hole. Hence the effective action of the charge is increased partly by an increase of the space available for tamping and partly by a concentration of the action toward the base of the hole, where it is desirable that the maximum amount of work should be performed.

More than one offspring of compressed gun-cotton has been similarly applied in mining industry. The application of this principle to the consolidation of powder grains, or of the more or less finely broken-up cake furnished by the powder mills or presses, was first made about twenty-three years ago by an American, Dr. Domnurs, with special reference to cannon powder, and has of late received important application in connection with the production of some of the most efficient descriptions of powder for heavy ordnance which we now possess. Its application to the production of blasting charges is unquestionably a boon to the miner. The powder is presented in a comparatively safe and convenient form, the loading of blast holes can be more expeditiously accomplished, and there is sufficient difference between the diameter of the hole and that of the particular size of cylinder used to allow of the charge being readily passed to the bottom of the hole, so that there is no necessity for the dangerous practice of ramming or driving the charge home with blows. Moreover, in addition to the more advantageous application of the charge to its work, when in its compressed form, as just now pointed out, the central perforation permits of the flame from the fuse being readily applied at the base of the charge. It was demonstrated by me, in a paper contributed to the Royal Society in 1869, that the violence of action of a powder charge is considerably increased by its ingition at the base, instead of near the upper end, for the reason that, under that condition, the main body of the charge, at the instant of ignition, presents a resistance to the escape of the gases first generated and thus momentarily establishes the pressure essential to the violent or perfect explosion of the gunpowder first influenced, whereupon the same character of explosion extends throughout the charge. This action may be strikingly demonstrated by means of two small heaps of mercuric fulminate placed upon thin sheet copper. If one of these heaps be inflamed at the edge or at the upper surface, the fulminate explodes with a dull thud, producing no impression upon the copper support, while if the other heap is ignited at the base (a platinum wire bridge, connecting the poles of a battery, being buried under the heap of fulminate), a violent explosion results, and the copper sheet is either deeply indented or perforated. Another method of producing charges of consolidated powder merits attention, although as yet it does not appear to have received important application. Colonel Viner, member of a Russian government commission, acting on a suggestion of Colonel St. Robert, heated the finely divided particles of mixed powder ingredients to the softening or melting point of sulphur, and by applying to the mass a moderate pressure when in that heated condition he utilized the sulphur as the binding agent. The powder masses thus produced were found to have considerable power of resisting deterioration by moisture: but their inflammability and the rapidity of their explosion were necessarily much inferior to those of powder made in an ordinary way. Experiments made at Woolwich Arsenal on this system of consolidating powder showed that it was by no means easy to produce thereby powder masses of fair uniformity as regards solidity. This difficulty must have also been experienced by Viner, as in subsequent experiments he is stated to have resorted to the plan of mixing the charcoal and sulphur with saltpeter heated slightly above its fusing point, a course of proceeding which does certainly not commend itself as a reasonably safe manufacturing operation. Mr. Nobel has also worked in the direction of applying the binding power of the fused sulphur to the consolidation of powder charges, and in order to obviate the uncertainty of action of such charges (unless very strongly tamped in thoroughly sound rock), due to their difficult inflammability and slowness of burning, he suggests the employment with them of a powerfully explosive percussion cap or primer upon the extremity of the mining fuse which is inserted into the cartridge. The objects of this detonating primer are to add to the heat applied to the charge through the agency of the fuse, and at the same time by its violent explosion to produce disintegration of the consolidated powder where it has been placed in position, and thus to promote its rapid ignition.

Although very few of the substitutes for blasting powder which had entered the lists against it twelve years ago and upward, and which are more or less analogous to the old black powder in their composition, survived the experimental stage, one or other explosive preparation of this class still comes to the front from time to time, its claim to originality consisting generally in the novelty of its fancy designation or in the addition, to the ordinary powder constituents, or to slight modifications of them, of some ingredients possessing mysterious functions, known only to the inventor and unfathomable by the chemist. Thus, many years ago a very crude kind of blasting powder known as Kellow's, composed of spent tan impregnated with saltpeter and sprinkled with sulphur (with the addition of a very small proportion of potassium chlorate, in the strongest variety), was manufactured for a short time in the neighborhood of Plymouth. Its comparatively safe character received practical demonstration by the factory being twice burnt without the occurrence of an explosion. That it failed to compete with common blasting powder, even as made twenty-five years ago, need hardly be stated. However, from time to time I have met again with my old acquaintance (though sometimes sawdust has been substituted for the tan) under a new alias, such as pyrolythe or pudrolithe, or espir powder, and each time it has been re-endowed, by the reinventors, with properties more remarkable, in point of safety and great explosive force, than it possessed before. Now, the addition of a little lampblack, and of that very original ingredient of an explosive mixture, ferrous sulphate, have imparted to it fresh features of novelty and virtue, and it appears before the world as the patent safety blasting powder, under which name it is warranted to explode only when desired, and without the development of any noxious gases or vapors whatever.

POWDER WITHOUT SULPHUR.

Among the more legitimate novelties in the way of blasting powders are those recently patented by Professor Himly, of Kiel, in which sulphur is absent, and which consist of mixtures of solid hydrocarbons, such as the paraffins, or of pitch, with saltpeter, and a proportion of potassium chlorate, crude benzol, which acts as a solvent of the hydrocarbon or pitch, being used as the means of mixing it intimately with the oxidizing agents. Facility and safety of manufacture, freedom from hygroscopic properties, and superiority in point of force are among the chief advantages claimed for these preparations, and there appears good reason why these should be realized; while, with the adoption of efficient arrangements for the recovery of the solvent, their economical manufacture should not present any practical difficulties. It may be interesting to refer to the fact that about twenty years ago, when the subject of the improvement of time-fuses was under consideration, and their construction for use with the then new breechloading Armstrong gun presented difficulties in respect to the fuse composition from the deteriorating action of atmospheric moisture, it occured to me to incorporate explosive mixtures with India-rubber, with the aid of benzol, whereby plastic or pliable sheets of regularly and more or less quickly burning fuse composition were obtained which were altogether free from hygroscopic properties.

PAPER BLASTING POWDER.

Another distinct form of explosive preparation which has been redevised at intervals during the past twenty-eight years for blasting purposes, and the employment of which in small arms and cannon has also been suggested, consists in making paper the medium for the application of explosive mixtures in very thin layers, which, being brought into close proximity to each other by a simple device, form a somewhat compact mass of explosive, burning with great violence when ignited at one extremity. The method of preparation consists in producing a mixture of saltpeter or chlorate, or both, with readily oxidizable substances in a very finely divided state, reducing the mixture to a thin paste with water or dilute spirit, applying this to the surfaces of sheets of thin bibulous paper, and then compactly rolling up the sheets, which have become coated with thin coatings of the mixture. When the rolled sheets are dried they furnish hard cylindrical masses, consequent upon the crystallization of the small proportion of saltpeter of chlorate which was dissolved in the water, and with which the paper has become impregnated. There are sufficient air spaces between the several layers of the paper rolls to promote the extremely rapid spread of fire throughout a mass of this kind, especially if it be confined. Before 1860 this form of explosive first became known to me as Hochstaedter's cartridge; about twelve years afterward it reappeared as a novel blasting agent and cartridge, for small arms, etc., under the name of Reichen's rolls; and lately my old acquaintance has reappeared under the name of dynamogen. Although this mode of applying explosive mixtures furnishes compact cartridges, which exhibit considerable violence of action, the energy stored in a given volume is small as compared with that developed from a cartridge of corresponding size of even, compressed powder. These rolls cannot, therefore, compete with the violent blasting agents of the present day, while the difficultly controllable rapidity of their explosion renders them unsuitable for projectile purposes, and dangerous to employ in firearms.

WHITE GUNPOWDER.

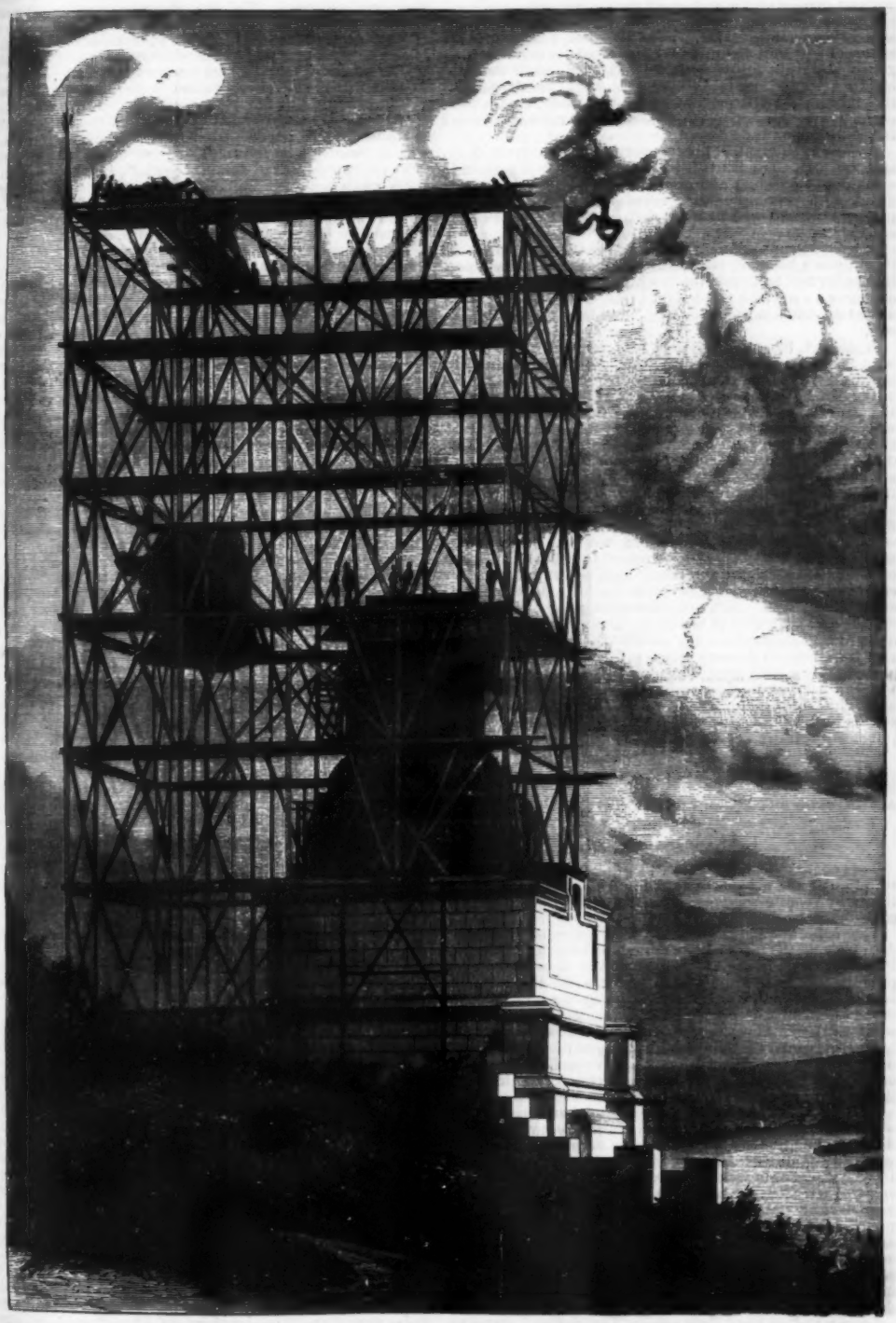
The comparatively great energy of potassium chlorate as an oxidizing agent has rendered its application to the production of explosive preparations a seductive subject of experiment and speculation ever since it became an article of commerce. For the production of detonating mixtures destined to serve as ready means for igniting charges of explosive material by the application of friction or blow, it has been invaluable, but the production of controllable explosive preparations by its means, which will compete not merely with powder but also with preparations of nitro-glycerine, and gun-cotton, has not been attended with really practical success, even since, thanks to some whom I have now the pleasure of addressing, its manufacture has been greatly cheapened. Many modifications of the so-called white or German gunpowder, known to almost the oldest among us when first we indulged in chemical experiments, have been produced, and extolled by their inventors to the skeptical miner, but such preparations as the powders of Horsley, Brain, and others have had to content themselves with becoming vehicles for the application of nitro-glycerine, and to enter the lists in this modest fashion against dynamite and blasting gelatine. Potassium chlorate has even been applied, in very special modes, together with sulphur, for the preparation of violent explosives; and pellets of chlorate and sulphur, ingeniously inclosed within soft bullets, for portable arms, were applied some years ago with success by M. Pertinset; but an international convention, soon after the Crimean war, prohibited the use of explosive bullets (though shells and torpedoes of the most elaborate and destructive character are legitimate engines of war), and so there was no field open for the chlorate bullet. Even quite recently, granulated powders, in which chlorate is at any rate the chief oxidizing agent, have been launched as competitors with sporting and rifle powder; but though some may possibly even rival certain gun-cotton powders for sporting purposes, the prospect of their bearing favorable comparison with our service small arm powder is, to say the least, very remote.

The necessity for a comparative, gradual, and progressive action in an explosive to be used in guns or small arms, so that the force developed may at once begin to expend itself in the line of least resistance (the movable part of the chamber in which the charge is inclosed, or, in other words, the projectile), and so that it may continue to be steadily maintained, imparting the requisite velocity of motion to the projectile, demands the fulfillment of conditions quite distinct from those which obtain in the application of an explosive agent to the cleaving or shattering of rock or the violent bursting of a shell. The difficulty of controlling the rapidity of action of an explosive agent, when the latter is in a confined space, is evidently not understood, or, at any rate, not sufficiently realized, by those who from time to time suggest that an explosive compound or preparation which, though in point of power it may be more or less superior to powder, is much quicker, and therefore more violent in its action, could with great advantage be substituted for the latter as a propelling agent, because a smaller weight would be needed to develop the same force, while other advantages, such as little or no smoke, diminished fouling, and above all that very delusive one, diminished recoil, are hoped to be secured. No better illustration could exist of that difficulty, and of the futility of devices for controlling the violence or rapidity of action of an explosive, when confined, which operate with perfect success in open-air experiments, than that furnished by the history of the attempts made to apply gun-cotton to projectile purposes.

GUN-COTTON.

Directly after Schönbein's visit to London in 1846, attempts were made by chemists and gunmakers to utilize that captivating discovery of his, gun-cotton wool, in small arms, and I well remember Mr. John Taylor, of Middlesex Hospital, giving an account at that time of experiments made by Lancaster, the well-known gun-maker, and himself, which resulted, if I rightly recollect, in the narrow escape of one of them, when after a few trials a rifle barrel burst explosively. Attempts to tame the violence of the

gun-cotton wool were soon abandoned. Some approach to success appeared at times to be obtained, but the development of destructive effect was not to be controlled. A quantity of the wool which could be harmlessly burned upon the palm of the hand would be on one occasion, or several times in succession, safely exploded in the rifle, and with good effect, when used in a particular way, but would on another occasion burst the barrel, a result which could not be traced to any discoverable difference in the nature of or mode of applying the material. When attempts to apply gun-cotton had long been abandoned in England and in France, partly on account of its apparently uncontrollable nature, and partly because of the occurrence of some very serious explosions during its manufacture, or when it was stored, destroyed all confidence in its stability, an Austrian officer, Baron von Lenck, steadily pursued experiments year after year, in spite of constant failure and of official discouragement, with a view to bring the rapidity of its explosion under control, and eventually—so far as its employment in small arms was concerned, in which the



THE GERMANIA STATUE ON THE NIEDERWALD AT BINGEN.—RAISING THE BASE PART OF THE STATUE. (See first page.)

charges and pressures to be dealt with are comparatively very moderate—he obtained a fair measure of success as regards the protection of the arm from any important destructive action, though he failed altogether in attaining any approach to the uniformity of effect of the ordinary rifle powder of those days. Encouraged by this amount of success, he proceeded to apply his system of controlling gun-cotton to the construction of cartridges for field guns, and a very few promising results led the Austrian government to construct a number of guns designed for use with gun-cotton. A disastrous explosion of the material at Semmering in 1865, however, put a stop to further experiments with it by the Austrians, who thereupon made a present to our government of the results of their investigations. The inquiry was then taken up by me, and a committee was afterward appointed by the War Office to report upon the possibility of applying gun-cotton to military and other uses. Many experiments were tried, upon Von Lenck's system of the action of controlling gun-cotton, by using this substance in the form of threads or twists, and winding, plaiting, or twisting these more or less compactly. No difficulty was experienced in greatly modifying the rapidity of burning the gun-cotton in the open air by those means, and, as already stated, the small charges used in rifles also burned less violently (though not uniformly so) than charges consisting of loose gun-cotton. But when very tightly twisted or wound gun-cotton thread was inflamed in the chamber of a gun which was nearly closed by means of a shot, the pressure developed by the first ignition of the charge caused the latter to be at once permeated throughout by the heated gases, and to be exploded with a rapidity and a violence not much inferior, and sometimes apparently equal, to those resulting from the ignition under similar conditions of a charge of loose gun-cotton wool. Even when subsequently the system of producing homogeneous and dense masses of compressed gun-cotton, from the very finely divided (pulped) fiber, was applied by me with more successful results to the regulation of its combustion (the material being to a considerable extent assimilated in compactness and density to gunpowder), perfect reliance could not be placed upon the extent of control exercised over the rapidity of explosion of a charge in a gun of small caliber, and a comparatively slight variation in the initial pressure developed upon the lighting up of the cartridge (a variation which, as far as the the preliminary experiments were carried, was very difficult to guard against), might, on the one hand, cause the charge to burn so slowly in the gun as to exert little propelling action, or, on the other hand, effect the more or less considerable disintegration and consequent violent explosion of the charge with injury to the gun. So far as small arms are concerned, we have been able, by application of further means of regulating the progressive ignition of the gun-cotton charge, to accomplish uniformity of action approaching that of powder, with a certainty of freedom from distressing action upon the arm. But I do not venture to hope that similar or even more perfect means of control will sufficiently reduce the susceptibility of gun-cotton to a capriciously violent explosion, when used in the comparatively large charges required for artillery, to allow of our using it as a substitute for cannon powder.

MODERN PROJECTILES AND POWDER CHARGES.

It must be borne in mind that from the period (about seventeen years ago) when rifled cannon were first introduced into our service, we have from time to time, as the size and attainable power of our guns increased, had to endeavor to modify the rapidity of explosion of our cannon powder in order to enable us to employ, without danger to the guns, the charges needed for propelling the increasingly heavy projectiles at the high velocity required to pierce armor or to penetrate or shatter modern fortifications. In illustration of the great change which has taken place in the nature of our artillery during the past thirty years, and in the nature of the work accomplished by the cannon powder of the present day, I may give you the following data: At the siege of Sebastopol, in 1853–55, the heaviest guns in use were cast in smooth-bore guns of 8-inch caliber, weighing 112 cwt., and throwing a 68 lb. shot by means of a powder charge of 18 lb. A few Lancaster guns (the first approach to a rifled gun used in the service) were supplied, these throwing a 10 inch shell by means of a charge of 12 lb. of powder. In the operations against the Alexandria forts, a year ago, the smallest gun used (of which there were only two, in one of our oldest iron-clads) was a 6½ ton gun, which threw a 112 lb. projectile with a charge of 30 lb. of powder. The intermediate guns were 9 tons, 12 tons, and 18 tons, throwing 8, 9, and 10-inch projectiles, which weighed 180 lb., 250 lb., and 400 lb., with charges of 35 lb., 50 lb., and 75 lb. of powder. The largest guns were 25 tons (12-inch), throwing 600 lb. projectiles with 85 lb. of powder, and 80 tons (16-inch), throwing projectiles 1,750 lb. in weight, with 425 lb. of powder. But some of our ships are now being supplied with 100-ton (17·7 inch) guns throwing projectiles of 2,000 lb., with 550 lb. of powder. This great advance in the power of artillery has been entirely dependent upon our power of controlling the rapidity of explosion of gunpowder when used in large charges, and it will, I am sure, be interesting to you to know that up to the present time we have been able to exercise that power to the required extent without introducing any alteration whatever in the composition of our powder. By simple modifications of its mechanical and physical properties, and of the manner in which it is burned in the gun, we have been able to attain velocities with our heaviest projectiles which were not dreamt of a few years ago, and with the development of pressures in the gun's bore, or of strains upon the structure of the gun, greatly below those which our cannon were formerly exposed to while furnishing very inferior results.

HEAT AND GASES OF POWDER.

The proportions of ingredients hitherto adhered to in this and in many other countries in the manufacture of war powder are those which develop, practically, the greatest total amount of heat. The volume of gas furnished by such powder is, according to the recent experiments of Captain Noble and myself, about 280 times that of the powder itself at 0° C. and 760 mm. barometric pressure, but one gramme of powder develops by its decomposition in a closed space 705 gramme-units of heat, the temperature of explosion being about 2,200° C. Hence the products of explosion of such powder, if fired in a perfectly closed space, which it entirely fills, have a tension of about 6,400 atmospheres, or exert a pressure of about 42 tons on the square inch. By the modification of the size, form, hardness, and density (and especially the first and last of these) of the powder, and by carefully studying the influence which the dimensions of the powder chamber in a gun, and the space which the charge occupies in the chamber, exert upon the pressures developed in different parts of the seat of the charge (which we have ready means of determining), we have, by progressive steps, which would weary you to recount, attained to such results as the following: From a 9-inch gun a 200 lb. shot is propelled by the discharge of 320 lb. of powder with a velocity of over 2,000 feet per second with the development of only 16 tons pressure on the square inch of the gun's bore; from a 10·4-inch gun a 462 lb. shot is propelled by 310 lb. of powder with the same velocity and with development of the same pressure; from a 12-inch gun a 714 lb. shot is propelled by 400 lb. of powder with a velocity of nearly 2,200 feet per second and a development of 18·8 tons pressure. Such results as these, which are not now exceptional, are greatly in advance of the best obtained even two years ago, as regards diminution of pressure, uniformity of pressure in different parts of the gun's bore, and high velocity. They are obtained with large cylindrical or prismatic powders of normal composition.

HARDENING SOFT LIMESTONES WITH FLUOSILICATES.

THE use hitherto made of alkaline silicates to harden limestones is far from satisfactory; it leaves the stone impregnated with soluble salts which are only expelled after long exposure to rain. These salts of potassa and soda rapidly nitrify, and assist the growth of fungous bodies, for which the potassa salt is a manure. Another mischievous consequence, resulting from this process, is the formation of an enamel impermeable to water upon the surface of the stones which have reached a point of saturation with the alkaline wash, and this enamel upon the arrival of frost imprisons the water, which freezing underneath this obstinate varnish forcibly detaches the glassy coating and breaks and injures the underlying surface. H. L. Kessler, according to *Les Mondes*, has apparently succeeded in replacing this indurating bath by a solution of fluosilicates of bases whose oxides and carbonates are insoluble in a free state.

When soft limestone is saturated with a concentrated solution of a fluosilicate of magnesium, aluminum, zinc, or lead, a degree of induration is soon reached which is very considerable. In fact, except the liberated carbonic anhydride, there is formed only flourspar, silica, aluminic oxide, and carbonates of zinc and lead or floride of magnesium, all of which are less soluble than the limestone itself. No varnish is formed, and therefore no danger threatened from the expansion of frost underneath it; the process has perfectly resisted the severe tests of winter, and this method of silification is only slightly more expensive than the old process it is intended to replace. It is frequently valuable to give to the surfaces of soft limestones the appearance and the polish of the hard marbles, if only to avoid the settlement of dust and soot upon their rough surfaces. In order to smooth and polish the coarsest limestone, it answers to coat it with a paste made of the pulverized stone and water, and after drying to impregnate it with the fluosilicate chosen for its lapidification. It forms a homogeneous body finely granular in texture, and as hard and refractory as the stone itself. It is only necessary to take some very simple precautions to avert the carrying away of fine dust in the beginning of the operation, caused by the rapid disengagement of carbonic anhydride. The skill in its application consists in flowing the solution in a thin film over a surface sufficiently dried.

When a coloring substance insoluble in water is mixed

with the paste, a very variable and interesting series of decorative effects is secured. Finally, by employing colored fluosilicates, as those of copper, chromium, iron, etc., the limestone is colored even in its interior by the formation of insoluble compounds. These colors follow the intimate construction of the stone, and afford designs of considerable beauty.

PERMANENT SILVER PRINTING.

Mr. Geo. Bruce, in the *Photo. News*, says:

"For fourteen years I have made silver prints upon collodio-chloride of silver paper, and find them, although exposed to hot climates, to be as permanent as when first made. When I first began collodio-chloride printing, I used paper made by Herr Obernetter, of Munich; but at present I am printing on paper made by Herr Linde, of Lubeck. Both these gentlemen's papers have given me equally good results. The collodio-chloride paper comes from Germany, carefully packed in zinc tubes, the tubes again being packed in wood boxes. A quire of collodio-chloride paper costs me, including carriage and packing, something like £2 10s.; but as there are now and again streaky sheets in the parcels, that will not produce good prints, the above sum scarcely covers the price I really pay.

The size of the sheets is 22 by 17 inches, which gives thirty C.D.V. pieces, or ten cabinets. More might be cut from the sheet, but as the edges sometimes fray in the toning and washing, it is better to leave a sufficient margin, so that when trimming the prints a clean and firm edge may be secured. The paper will keep good in a cool place for two or three months.

The printing should not be so deep as when using albumenized paper, as collodio-chloride prints lose very little of their vigor in passing through the toning and fixing baths.

Collodio-chloride prints may be kept for a considerable time before toning—two or three weeks may elapse—but I prefer toning as soon after printing as possible.

The toning bath is made as follows:

STOCK SOLUTION.—No. 1.

Sulphocyanide of ammonium.....	1 oz. 2 drachms.
Distilled water	60 ounces.
Hyposulphite of soda	9 grains.

STOCK SOLUTION.—No. 2.

Pure gold	11 grains.
or	
Chloride of gold.....	22 "
Distilled water	60 "

FIXING BATH.

Hyposulphite of soda	1 ounce.
Distilled water.....	12 ounces.

The gold I use for toning is prepared according to Col. Stuart Wortley's formula, given in the "Year Book" for 1871, p. 91; and it gives in my hands more uniform results when toning collodio-chloride paper than I ever obtained with the ordinary commercial samples of chloride of gold. Why, I cannot tell, any further than that in preparing your own chloride of gold you know exactly what you have at hand, and strength of the toning bath is more under your control.

This "control" is absolutely necessary to success with collodio-chloride papers, as I find that anything more than the strength given in the formula produces a flat, eaten out picture without any depth; while, on the other hand, too weak a toning bath gives heavy opaque brown tones. Thus, if the toning goes on too quickly, you lose depth and richness; if very slowly, a brown, leathery tone is produced, which is far from satisfactory.

The reason in the first case is that the prints pass so rapidly from brown to black, that before you can well get them removed from the bath, the point where richness lies is often lost. And in the second place, the sulphocyanide of ammonium solution in some measure destroys the transparency and purity of the prints when they are left too long in contact with it. Particular care and attention must therefore be given to the toning bath, so as to have it neither more nor less than the strength stated, as collodio-chloride photographs are much easier stained in toning than prints upon albumenized paper; and when unequal toning does take place, it is more visible in the former than in the latter.

In making up a bath, equal quantities of No. 1 and No. 2 are mixed, plenty of chalk being added, letting the whole stand for from three to five hours before use.

With some samples of this paper, the bath can be used at once; but with other sheets this is not the case, a deposit of gold taking place over the whole prints and destroying the purity of the whites. It is better, therefore, to err on the safe side by making up the bath a considerable time before it is required, and thus be assured of having a uniformity in one's photographs.

When I have many prints to tone, I use two flat dishes capable of holding, say, a dozen prints each. I filter the solution into these dishes to the depth of one quarter of an inch; were the liquid deeper the prints would not keep flat. I wash in three changes of water; and as the prints generally curl up into tubes, I open each of them separately in the water, so as to get the surface uniformly washed. If this is not done and done in each separate dish of clean water, uneven toning will be sure to take place.

When the prints have been properly washed with a quick but gentle movement, I open up each picture, and lay it flat in the bath face downward; and when the dish is full, I begin at the first and turn it over, brushing the face with a camel's hair brush, and continue the process until the whole have been so treated, afterward turning them back again into their former position, and so on without cessation, until the prints are ready to leave the bath. When stains occur in the course of toning, lift the print out of the solution, dip the brush in alcohol, and rub the spot slightly. Then immerse the print again, when it will be found that the stain has disappeared, and the print has been saved.

When fixing the prints, the same care is required in laying them separately in the fixing solution, turning them over, and keeping them in motion until they are fixed, which is completed, when the fixing bath is new, in from three to five minutes. When removed from the bath, the prints are immersed for a few minutes in three or four changes of water, and put under the tap for an hour or two. The water is then shut off and they are left all night and throughout the next day until the afternoon; the water is changed now and again. The prints are then trimmed and mounted.

The system in use among many of the profession, of cutting the prints to the exact size wanted before toning them, cannot be readily adopted with collodio-chloride pictures. In their case the paper should always be a little larger than is necessary, allowing not less than one-eighth of an inch to be cut off all round after the prints have been toned, fixed, and washed. The reason for this is that the edges of the prints are very curly, and the film becomes frayed in the course of washing; by cutting away this frayed curly part, they are more easily and neatly mounted. As it is impossible to lay these prints upon blotting paper and dry them in a flat state without cracking the surface, another method has to be put in practice for the purpose of trimming them. I use a piece of thin plate glass, cut to the exact size of what the *carte de visite* print should be, the edges being ground and the corners slightly rounded, so as not to scratch the picture. If the prints are more than ordinarily curly, I open them *underneath* the water and lay the sheet of glass upon the face, and then lift both of them out of the water at once, the moisture between the two enabling me to move and adjust the glass over the print with the greatest ease. I then, with a pair of long bladed scissors, cut along the four edges of the glass, and thus secure a straight, clean cut print, without damaging the surface of the photograph.

The medium I use for mounting is starch, carefully boiled, as thick as possible. It is, while still warm, poured into the center of a muslin cloth, the corners of which are drawn together and held firmly with the left hand, while the right hand presses the bag and causes the pure starch to exude through the interstices of the cloth—the result being a paste perfectly free from gritty matter, and of the right consistence for mounting.

A sheet of thick plate glass is covered with a damp cloth, and the prints are lifted from the dish and laid upon it in a wet condition, the water on the face of the prints and the damp cloth preventing them from curling. They are then pressed quite flat with another cloth, and dried before they are starched.

After the prints are mounted, dried, and spotted out, I roll them upon a hot steel plate; they are then put up in dozens into paper and laid upon the machine plate, and when warm are rubbed over with "Solomon paste,"* which gives them a richness and transparency they would not otherwise possess.

If desired, these photographs may very easily be covered with "Mawson's print varnish" or "enamel collodion," by coating them with a camel's hair brush of the same breadth as the card. In my own practice, however, I rarely varnish the pictures, as I think they are more beautiful and artistic when simply finished with wax paste. After fourteen years' experience, I can speak with a considerable degree of confidence regarding the stability of collodio-chloride pictures. I am not, however, prepared to assert that out of the many thousands of photographs which have left my hands throughout the course of these years, none of them have faded. At first the manufacturers of collodio-chloride papers were not so careful as they are now regarding the basis on which the collodion film rests; nay, I have reason to believe that sheets of albumenized paper were then used as a support for the emulsion. In such a case, the prints made from those sheets are liable to fade. But, notwithstanding this, the fact remains—and I am glad to be able to say so—that out of many dozens of photographs in my possession, dating back to the year 1869, I do not find any fading prints among them. Some of these prints have been lying loosely on shelves in a room where I have made up developers, boiled negative baths, made chloride of gold, toned, washed, and rolled my photographs for nearly a decade of years, and yet, so far as I can judge, they still retain their pristine purity.

* See "Standard Formulæ," in "Year Book."

PERFUMES AND ESSENTIAL OILS.†

A NEW MODE OF EXTRACTION BY MEANS OF VACUUM AND COLD.

By Laurent Naudin.

This communication has for its principal object the description of a new mode of extraction of essences and perfumes by volatile solvents with the aid of vacuum and cold.

The collection and preparation of odorous substances date back to the most remote periods of historical tradition. Perfumes have, in short, from the earliest ages occupied a prominent place in the religious services of the most diverse nations, and even in the present day incense is burnt in the ceremonies of many creeds. The etymology of the word perfume alone—*per fumum*, by smoke—shows the manner in which the substance it designates was used, and that the art of combining delicate and refreshing odors, or more properly the art of the modern perfumer, originated in the ancient custom of burning incense on the altar.

This art has been handed down during several centuries without any great modifications. Thus the processes for the extraction of essential oils and the preparation of waters and scented oils that were used in India and by the Arabs are the same as those carried on in the laboratory of the modern perfumer. Mechanical improvements have aided in perfecting the apparatus, which, however is not very complicated. Progress has been made, not in the extraction of the rich and varied perfumes of nature, but solely in the compounding of mixtures of perfumes. Indeed, it is curious to read in ancient writings textual descriptions of the principles upon which the processes still employed in the current manufacture of perfumes are based.

Lenormand, in his "Traite de la Distillation," states expressly that the Arabs have from time immemorial effected the extraction of the aromatic parts of plants by distillation. These people in their incursions into Europe introduced their processes successively into Italy, Spain, and France. But in France this industry was localized first in the department of Hérault, from which it has almost completely departed to settle in Provence, under the beautiful climate of the Alpes-Maritimes. Algeria commenced to send her products into the market, but owing to the absence of any systematic cultivation of flowers the perfume industry in this French colony has nearly died out. Thirty years ago Millon called the attention of perfumers to the immense resources of Algeria, but his urgent appeal, though justified by the richness of the Algerian vegetation, was not listened to.

At present essential oils and perfumes are obtained industrially by distillation, hot and cold enfleurage, and expression.

The mode of extraction by distillation with steam consists in placing the odoriferous vegetable substances (flowers, seeds, wood, roots, etc.) together with a certain quantity of water in an ordinary still, and heating to the boiling point. Under the influence of this temperature (100°) the plant cells are ruptured, and the essential oil carried over mechanically by the steam is condensed with it in a cooled receiver and separated in an oily form. Formerly the heat was applied by a naked fire, but the essential oil then acquired a very marked empyreumatic flavor; recently the use of steam has replaced this barbarous way of applying heat.

There are two great objections to this mode of proceeding—the destruction of a part of the perfume, owing to the high temperature that is necessary, and the great modification sustained by the undestroyed portion of the perfume from contact with the steam. Consequently the essential oils obtained by this mode never contain the perfume of the flower in all its perfection, but inevitably possess an odor known to perfumers and distillers as the "flavor of the still." The quantity of perfume destroyed by the steam may amount in certain cases to as much as 50 per cent.

In the hot enfleurage the flowers are digested for a sufficient time in oil heated in a water-bath. When exhausted they are withdrawn from the oil and submitted to a strong pressure in order to recover the fatty matter with which they are saturated. To the inconveniences enumerated when speaking of distillation, the following may be added: (1) the loss of the fat remaining in the cake of flowers submitted to pressure; and (2) the rancidification of the fatty matter when heated to a high temperature. It is known in practice that the glycerides heated to 100° C. acquire a rancid flavor.

Cold enfleurage is adopted in the case of the more instable perfumes, which are destroyed by heat, rendering it necessary to impregnate the oily body at a low temperature. For this purpose the flowers are laid in contact with a linen cloth saturated with oil or on a glass tray having a layer of oil spread over the bottom. The flowers are renewed at intervals of twenty-four hours. One inconvenience of this primitive method is the rapid rancidifying of the oily matter under the influence of a partial fermentation of the flowers and of the humid temperature of the climate in which it is necessary to carry on these operations, and the consequent alteration of the perfume. It may be mentioned that in the flower season, the same oily matter stands, for a month at least, in contact with air at a temperature of 35° to 45° C. Besides this there is a loss of a great part of the perfume, the flowers never being quite exhausted when renewed, as well as the loss of the oily matter left in the flowers. To obviate these inconveniences, it has been proposed to employ glycerine and sirup of sugar in the place of oil and fat in the processes of hot and cold enfleurage. Neither of these bodies is susceptible of rancidity, but the solubility of glycerine in alcohol, and the instability of sirups when exposed to contact with air, have prevented their practical employment.

Several years ago paraffin and vaseline were tried as substitutes for olive oil in hot enfleurage; but paraffin has been abandoned, while vaseline yields alcoholic extracts of which the perfume is contaminated with a petroleum odor.

Expression is undoubtedly the best of all the processes at present in use. It is applied, however, only to a limited class of oils; those of the lemon, bergamot, orange, cedrat (*Citrus medica*), and lime (*C. limetta*). The products derived in this way from the rind of these members of the genus Citrus are incomparably superior to those obtained by distillation or enfleurage.

In 1835, Robiquet described the preparation of the delicate perfume of jonquil by means of ether, but the process was not then carried out industrially. Two years after, Buchner, in a note on "L'Arome de quelques Fleurs," expressed the idea that practical application might be made of Robiquet's method. Afterward, Millon, the principal of the Central Chemical Laboratory in Algiers, in an able memorandum on the nature of the perfume of flowers and on some flowers that might be cultivated in Algeria, mentioned a series of experiments as to the employment of volatile solvents in the extraction of perfumes of flowers. The solvents were chloroform, carbon bisulphide, ether, methylic alcohol, vinic alcohol, etc.; but he distinctly gave the preference to ether. His coworker, Ferrand, took out a patent with this object, in which he described the mode of working. It consisted in introducing the flowers into a displacement apparatus, covering them with ether, and allowing the liquid to run after being in contact for about ten minutes. The ether was evaporated in an ordinary distilling apparatus, the perfume being left as residue.

Apparently Millon and Ferrand had no knowledge of Robiquet's experiments twenty years before, but however this may be, the results announced by Millon were important. Trials were made on a large scale, but it was nevertheless found necessary to abandon this process on account of the danger of using large quantities of ether in open vessels and the loss of a considerable quantity of the solvent in each operation, through its being impossible to drive off the last traces of it from the perfume. Dr. Quesneville, as early as 1857, had perceived and pointed out the moderate practical value of the process. Since that time, however, new attempts have been made in the same direction, some of which are worthy of notice.

An industrial experiment of Lemettars and Bonnière, of Rouen, had for its object the extraction of the perfume from dry species and fresh plants by carbon bisulphide rectified by treatment with alkalies and lead salts.

Deiss, of Marseilles, introduced a system of purification of perfumes extracted by carbon bisulphide. In his patent Deiss stated that the employment of carbon bisulphide, easily decomposed by the water contained in fresh flowers, communicated a sulphurous odor to the perfumes. He therefore proposed to wash the perfumes with an alkali solution or a solution of monosulphide of sodium for the purpose of removing chemically the solvent retained mechanically by the perfume mixed with the wax of the flowers. Considering the extreme alterability of certain perfumes by alkalies, this idea was hardly a happy one.

Then came the experiments of G. Ville with chloroform and De Hirtzel with the light petroleums. Neither of these modifications of Millon's method was, however, able to stand a practical test.

The official reports of the Exhibitions of 1862 and 1867 show that the question of solvents had not yet been solved. The reporter at the Exhibition of 1878 mentioned as the only improvement worthy of notice the substitution of steam for the naked flame in the heating of vessels; no mention was made of the industrial employment of volatile solvents.

It is only just, however, to notice the persevering efforts of Piver to replace the ordinary process of enfleurage by what he called the pneumatic method. Piver also proposed in 1863 the washing of the perfumes extracted with carbon bisulphide with an alkaline solution, an idea that had already been patented by Deiss.

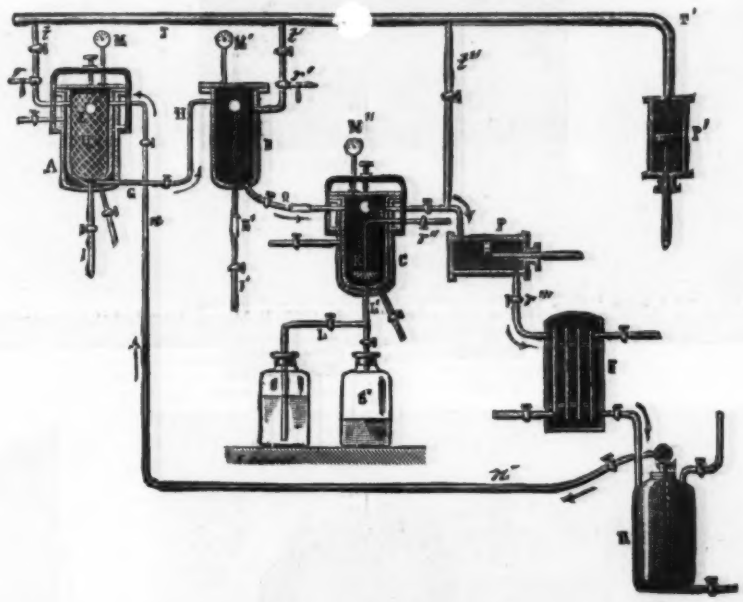
This rapid *resume* will show that the use of volatile

† Abstract of a paper in the *Moniteur Scientifique*.

solvents had not been rendered practical, because (1) owing to the work being done in open vessels, there was a great danger of fire and serious accidents; (2) the loss of the solvents was not less than ten per cent. each treatment; (3) for the purpose of entirely getting rid of the solvent, it was necessary to raise the temperature considerably, and in doing this the perfume was sensibly altered. Therefore, notwithstanding the incontestable truth of the principle discovered by Robiquet, this method has been practically abandoned.

The author of the present paper, M. Naudin, has been occupied with the study of this question for four years, and has contrived an apparatus by which he seeks to avoid the causes of failure before mentioned. This apparatus, based on the distillation of volatile solvents in closed vessels in a vacuum and at a very low temperature, is composed of the following six elementary parts: (1) A digester (A) in which the perfume is extracted by contact of the volatile liquid with the odorous substance. Instead of a single digester, a series of vessels can be used communicating with each other in such a manner as to allow of a systematic exhaustion being carried on. (2) A decanting vessel (B) in which the perfumed solution is purified by decantation from the aqueous portion of fresh flowers, removed mechanically during the digestion. (3) An evaporating vessel (C) in which the volatile solvent is distilled off, leaving the perfume as a residue. (4) A suction and forcing pump (P) for the purpose of hastening both the distillation of the volatile solvent by the aspiration of its vapors, and the condensation and liquefaction of the vapor, by compression in the refrigerator (F), and to collect, at the end of the operation, the traces of the solvent remaining in the different parts of the apparatus and drive them into the refrigerator (F). (5) A cylindrical refrigerator (F) in which the volatile liquid is condensed. The condenser is kept cool by one of the known methods, such as ammonia, sulphuric acid, etc. (6) A receiver (R) in which to store up the solvent employed.

The three vessels, A, B, C, and the refrigerator can be hermetically closed by means of joints. The tube, T, T', which is in connection with the whole apparatus, distributes the vacuum caused by the pneumatic pump (P). This tube communicates with the vessels, A, B, C, by the tubes, t, t', t'', supplied with taps. Air is readmitted at pleasure by r, r', r'', r''', or by means of compressed air, consisting of



air removed from the apparatus and forced into a special receiver. The manometers, M, M', M'', indicate at any moment the state of the vacuum in each vessel. The level of the liquid solvent is shown by means of a glass window in each vessel (see E in A). The vessels, A, B and C, have each a double lining so as to allow the introduction of air or hot or cold water.

The flowers, leaves, etc., are introduced into the digester (A), and confined in a basket (U). The vessel is closed, and a vacuum, obtained by opening the tap (t), causes a suitable quantity of the solvent to ascend from the receiver (R) by the tube, n, n'. The materials having been left to digest for about fifteen minutes, the solvent liquid charged with the perfume is passed from A into B, in which a vacuum has been previously made, by connecting A and B by means of the tube, G, H, which proceeds from the base of A. The water contained in the flowers is carried over mechanically by the solvent, and accumulates at the bottom of the vessel, B, whence it is got rid of by the tube, I. A glass window (E) allows the distinct separation of the two liquid layers. Communication being established between the evaporator (C) and the refrigerator (F), a vacuum is established by means of the tube, t''; the solvent, charged with perfume and free from water, is then allowed to run from the vessel (B) into the evaporator (C). Communication between B and C is then closed, and the refrigerator (F) cooled energetically, after which the pump (P) is set to work. The vapors of the solvent are drawn from C, and then forced into and rapidly condensed in F. During the distillation, the evaporator (C) is kept at the temperature of the surrounding atmosphere; this is effected by passing a current of water between the double lining, which restores the latent heat borrowed by the volatile solvent upon its conversion into vapor.

When a very energetic source of cold is at disposal, the employment of the pump as a means of liquefaction may be dispensed with. In this case the vapor passes directly from C to F. After complete evaporation a white or colored residue is found on the sides of the evaporator, C, which may be a solid, liquid, oily, or semifluid substance, eventually becoming solid.

When the distillation is finished, the distilled liquid condensed in F is allowed to run into the receiver, R. If a sufficiently low temperature has been maintained during the distillation, this liquid will not be sensibly tainted with any odor, and may be used in the manufacture of different perfumes. The perfume mixed with the wax of the flowers and leaves, dissolved also by the ether, requires to be separated. For this purpose, a given quantity of alcohol, contained in the vessel, S, is drawn up through the tube, L, by means of a vacuum into C, and is left there to digest some time. Solution is favored by the readmittance of air through K, which agitates the mass violently; the liquid is then drawn off into the vessel, S, which is kept at a temperature of – 10° in order to precipitate the wax, while the perfume remains dissolved in the alcohol, and the whole is filtered at the same low temperature. The perfume thus prepared consists of an alcoholic solution.

In the manufacture of perfumed oils or fats, this manipulation with alcohol is not necessary: the perfume, mixed with its natural wax, is dissolved in the oil or lard, which are the vehicles generally employed.

The exhausted flowers in the digester, A, mechanically retain some of the solvent. To recover this the mass is heated by the introduction of steam into the outer jacket, and the solvent is condensed in a special refrigerator. The employment of a vacuum allows the whole of the solvent to be recovered.

It will be seen from the foregoing description that the movement of the solvent liquids from one vessel to another is effected simply by differences of pressure, and that the volatile liquid circulates in closed vessels in a vacuum, without ever coming into contact with the outer atmosphere while passing from liquid into the gaseous state, or *vice versa*.

The other advantages presented by this apparatus are that there is no danger of fire; the perfume is completely and quickly extracted, however unstable it may be; solution is effected in a few hours in an appropriate menstruum (alcohol, oil, grease, or glycerine); pure perfumes, containing all the aroma, are obtained, owing to the low temperature maintained during the extraction; the perfumes are condensed in an exceedingly small volume, and in a form which allows them to be kept for an indefinite period; the greater value of the yield from all the perfumes than in the old method; and the use of extremely volatile liquids, among which the following have been tried:

	Boiling point.
Hydride of butyl	0°
Hydride of amyl	30°
Chloride of ethyl	9°
Chloride of methyl	–23°
Light petroleum spirit.	

The choice of a solvent for a particular perfume is not without importance, the delicacy and sweetness of a perfume depending upon the nature and purity of the solvent. This method yields extremely delicate results, and in operating with care the slightest variation in nature may be reproduced with extraordinary fidelity.

Commaille reports that the separation of the odor of the milk of the cow has enabled Millon, as well as himself, to recognize certain plants eaten by these animals, the *Smyrnium olusatrum* among others. M. Naudin has made a series of experiments which show what accuracy can be obtained in this direction. By using a mixture of hydride of butyl and amyl as a solvent, he has been able to distinguish clearly and isolate the perfume of roasted coffee from different sources. He obtained a similar result with the fine shades of quality in tea. He also gives instances of isolating and fixing different special odors, as toasted bread, the human skin, raw or cooked food, earths, etc.

The time of collection of the flower is very important. Each flower must be gathered at an appropriate time of the day, and in a certain degree of bloom which experience alone can recognize. Thus the pink only yields its perfume when collected two or three hours after being exposed to sunlight. On the contrary, roses must be gathered in the morning as soon as they are well open. The flower of the jasmine ought to be picked a few minutes after the first exposure to sunlight. The false acacia always gives a fragrant perfume, but differing according as the flower is gathered in the morning, in the evening, or even in the middle of the day.

In distillation, as Millon has already remarked, all the modifications of the flower are mixed in one and the same essence, which does not resemble any of them exactly; but probably the mixture corrects, up to a certain point, the defective parts of the collection. In the new mode of extraction, the slightest alteration, the least variation in the state or quality of the flowers, is revealed in a perfume; to obtain, therefore, a perfume possessing all the freshness and fragrancy of the flowers it is necessary that the flowers used be fresh and fragrant.

The perfumes obtained by the solvent method, instead of dissipating like ordinary essences, are marked by a great permanence. In fact, perfumes become altered by contact with other principles of the plant, which involve them in their own decomposition; but when once isolated from the destructible organs of the plant, the perfumes escape their influence, and obey their own laws of transformation or decomposition.

Millon states that he has kept isolated perfumes for several years in open capsules or tubes, without finding any sensible loss. M. Naudin also has experimented on perfumes that have been in his possession four years. The experiments were at first limited to flowers gathered under the climate of Paris, such as the pink, narcissus, violet, rose, lilac, hyacinth, the lily of the valley, etc.; but have since been extended to the flowers of Cannes, such as the orange, rose, jasmin, false acacia, and tuberose. All the perfumes obtained from these flowers have remained unaltered even in contact with air.

As already stated, the perfume, although it remains unaltered in the presence of the oxygen of the air, becomes involved in the general decomposition if left in the presence of the decaying organism of the flower from which it was derived. Now, the decomposition of certain flowers when plucked from the plant is extremely rapid; it is therefore obvious that when the apparatus for extraction is at a distance from the place of collection, the perfume obtained does not exactly resemble that of the flower, even when extracted by the solvent method. Thus, it is known that the essence of neroli manufactured at Cannes, the center of floral cultivation in the Alpes-Maritimes, is superior to that made at Grasse, about ten miles distant. The reason is that some time is necessarily lost between the moment of gathering and the time of manipulation; besides this, there is the transport of flowers in the hottest days of summer, the effect of which is manifest in the diminution of the yield.

The above inconvenience can be met by keeping the fresh flowers in a special vessel, void of air and full of vapor of the solvent, as of ether. The presence of the latter body and the absence of oxygen prevent fermentation, especially if the temperature be kept sufficiently low. The perfume of the orange has thus been kept in its intensity with the flower itself for a month. A manufacturer could thus preserve his materials from fermentation upon the days when the great abundance of flowers—sometimes 20,000 to 30,000 kilogrammes—would render his digesters of insufficient size to treat the whole at the same time.

The chemical nature of perfumes has been studied by Millon. He recognizes two classes, the essential oils and the perfumes, properly so called. His experiments led him to the conclusion that the extremely small quantity of these bodies contained in the flowers renders their chemical study difficult, if not impossible. In a great number of cases only a milligramme of pure product can be obtained from a kilogramme. He is of opinion that the perfume of flowers is a fixed or rarely volatile principle, remaining unchanged in air and contained in the flower in only imponderable traces. It is decomposable by heat when the temperature is raised above the ordinary limits of the atmosphere, but is nearly always volatile without apparent decomposition in alcohol, ether, oily bodies, and a great number of liquids, such as carbon bisulphide, chloroform, benzine, etc. The perfume is nearly indefinitely diffusible in air, that is to say, it vaporizes and denotes it presence there by a fragrant odor, but does not suffer a sensible loss of weight. It is equally diffusible in water, to which a beautiful aroma can be imparted by the addition of a few drops of an alcoholic solution of perfume.

As already mentioned, Millon makes a distinction between essential oils and perfumes. M. Naudin thinks this may be correct as long as the term essential oil is confined to those of which the odor forms an integral part of the properties of the body, such as the oil of wintergreen or salicylate of methyl. Most of the oils with well defined chemical functions (alcohol, phenol, ether, etc.) may be entered in this class, but the oils of the genus Citrus and of the labiates cannot be included in the broad definition which Millon gives. He also believes that in many cases the isomeric hydrocarbons of the group C_nH_{2n-4} are probably only the substratum of the perfume. A very simple experiment tends to prove this. If the oils of lemon, bergamot, orange, lime (*C. limetta*), and cedrat (*C. medica*) be boiled for a short time with a slight trace of caustic soda, the odor peculiar to each oil will be replaced by a common odor similar to that of terpene—$C_{10}H_{16}$. Indeed, the energetic action of caustic alkalies is not necessary to destroy these odors, since light alone, aided by time, has enough influence over these oils to change their special odor into that of oil of turpentine. Oil of angelica, obtained from an umbelliferous plant, gives a $C_{15}H_{24}$ carbide—terebangeline—with an odor of hops, and possessing the same organoleptic character.

Further than this, these general considerations on perfume can be applied to the special odor of fatty oils. No attempt has yet been made to isolate the perfume dissolved in the glycerides, but no doubt it would reveal the same fact, the solution of a very minute quantity of a very odorous and strongly flavored body in an inodorous or nearly inodorous vehicle.

Perfumes have not yet been chemically classified; their organoleptic character alone has served to distinguish them, through want of a more intimate knowledge of them. The question therefore remains very obscure; but M. Naudin is sanguine that this new mode of extraction, by putting uncontaminated substances within the reach of chemists, will allow of deeper research into their nature. In any case he believes that therapeutics will find, in pure perfumes, a new field of research, and will perhaps discover the means of applying them as medicaments.—*Pharmaceutical Journal.*

SIR ROBERT RAWLINSON, C.B.

HER Majesty lately conferred the honor of knighthood upon this eminent civil engineer and most useful member of the Civil Service, who has long held the office of Civil Engineering Inspector of the Local Government Board, and has now retired at seventy-three years of age, having been in the Government service thirty-five years, and having done a vast amount of very important work. He was, though born at Bristol in 1810, the son of a builder at Chorley, Lancashire, in which town he learned to work with his own hands as a mason, bricklayer, and carpenter, and afterward as a mechanical engineer, before entering the Liverpool Dock Engineer's office, in 1831, under Mr. Jesse Hartley. In 1836, he was employed under Mr. Robert Stephenson in the construction of the London and Birmingham Railway, after which he returned to Liverpool as assistant surveyor of the docks. At the end of 1844 he became engineer to the Bridgewater Canal. In 1847 he devised a scheme, which was admired but never carried out, for supplying Liverpool with water from the Bala Lake; and he took part in the erection of St. George's Hall, at Liverpool. He was appointed an engineering inspector under the first Public Health Act, 1848, Lord Morpeth, Lord Ashley, and Mr. Edwin Chadwick, C. B., being commissioners. Mr. Rawlinson held the first inquiry and wrote the first report, on Dover. Subsequently he visited, inspected, and reported upon the principal towns in England, from Berwick-upon-Tweed to Penzance, from Liverpool to Scarborough. He drew up suggestions for the

use of local surveyors and sanitary engineers as to main sewering, house draining, water supply, and sewage irrigation. These plans have, from time to time, been extended, so as to be suitable, not only for Great Britain, but also for British India and the colonies; they have been accepted by foreign as well as by English engineers. In the spring of 1855 Mr. Rawlinson was sent as a member of the Sanitary Commission to the British Army, where he caused measures to be adopted which soon reduced the rate of mortality among our soldiers in the Crimea, and in the military hospitals on the Bosphorus, after a frightful number of deaths, from the want of proper care in cleansing, ventilating, and furnishing pure water, had taken place among our soldiers. Within six months, the measures which were taken by Mr. Rawlinson and his medical colleagues, Dr. Sutherland and Dr. Hector Gavin, brought the whole of our army into a better state of health, with a lower rate of mortality, than it had ever before enjoyed in barracks at home. The improvement thus begun has been continued by the directions of other sanitary committees in the War Department, reducing the average mortality of British soldiers, at home and abroad, to less than half its former rate. In 1863, Mr. Rawlinson was sent by the Home Secretary to Lancashire as Commissioner to devise work for the people in the distressed cotton districts during the cotton famine. Mr. Rawlinson, with Mr. Arthur Arnold, his colleague, advised and superintended in ninety-four towns and places in Lancashire and Cheshire, works of road making, public parks making, waterworks construction, street and road forming, main sewering, and land draining. The sum of money expended under the signature of Mr. Rawlinson was £1,850,000, and upward of 400 miles of roads and streets were formed, drained, sewered, channeled, and paved, the manual labor being done for the most part by cotton operatives. The administration did not cost the Government 3s. 6d. per cent. The money was advanced for a period of thirty years at 3½ per cent., and the entire sum has, up to this date, been regularly repaid. Sir Robert Rawlinson was nominated a Companion of the Bath, in 1865. He has served on three royal commissions in England and on one for Dublin, and since 1862 has been a member of the Army Sanitary Committee. He is a member of

SIR ROBERT RAWLINSON, C.B.

the Council of the Institution of Civil Engineers, and a vice-president of the Society of Arts.

The portrait of Sir Robert Rawlinson is from a photograph.—*Illustrated London News.*

EXPERIMENTS ON PLATED FORTS AT SHOEBURYNESS.

ON Tuesday, August 22 last, an experiment of great interest, especially to England, took place at Shoeburyness. It was carried out by the Royal Engineers with a view to testing the amount of protection afforded to granite forts by iron plates. The nature of the work tested is shown in the accompanying sketches. Fig. 1 shows the front, which is divided in four portions, the thickness of each being shown roughly in Figs. 2 and 3; that is, the plan and end elevation of the work. Reading from left to right, No I. consists of 40 ft. thickness of granite and concrete; Nos. II. and III. of 20 ft. of granite and concrete, backed by about 20 ft. of earth, but strengthened in front by iron shields, seen in Figs. 1, 2, and 3, hereafter to be described; and No. IV. consists of 40 ft. of granite and concrete. A small passage, of sufficient size to enable a man to creep through it, is pierced through the work parallel to the face and 20 ft. from it, opposite portions II. and III., which would enable the effect of the fire to be better seen—so it was supposed, and so it proved. The shields fixed on the face of portions II. and III. are as follows: that on No. III., against which the first shot was to be fired, consists of two plates of 8 in. thickness each, of wrought iron, sandwiched with 5 in. of wood behind each, made up of two thicknesses, that is, 2½ in. planks laid horizontally, next behind each plate, and 2½ in. planks behind them placed vertically. The dimensions of each plate were as follows: length 12 ft., height 7 ft., and thickness 8 in. They were supplied by Messrs. Cammell. They are held in their place by six bolts, on the Palliser English system.

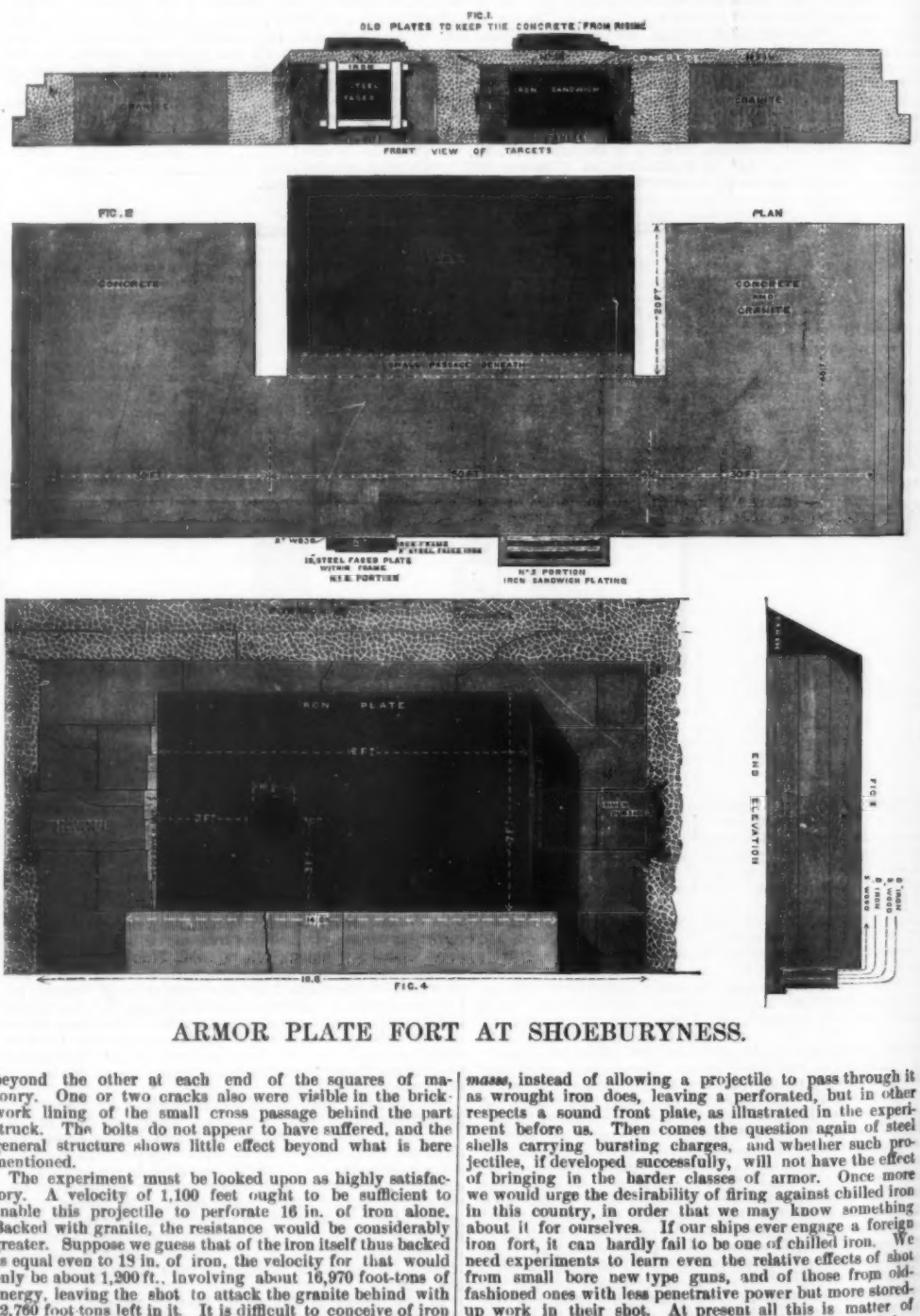
The shield on portion II. consists of 12 in. of Wilson's compound or other steel-faced iron, in a plate 7 ft. by 7 ft., fixed inside an iron frame, as shown in Figs. 1 and 2. In the top of the work was laid a quantity of old broken plating, to keep the masonry and concrete from rising under the force of the blow—*vide* Fig. 1, at portions II. and III. We can hardly think that structures of granite and concrete would attain their full strength for many months, perhaps years to come, and must allow for this in this trial, which it will be seen is a very severe one.

The gun employed is the 80-ton gun, M.L., which is mounted at 200 yards distance. One round was fired from it on Tuesday at portion III.—iron sandwich on granite. A brief report of this appeared in the *Standard*, by which it was stated that a projectile weighing 1,700 lb. was fired with a charge of 450 lb. of pebble powder, with a velocity of 1,588 ft. This implies a total amount of stored-up work of about 29,730 foot-tons, or 594·4 foot tons per inch circumference, representing a power of perforating about 25 in. of iron. The shot was a service Palliser, chilled iron projectile, of about 3 ft. 8½ in. long, fired without bursting charge, the radius of the head being about 1½ in. diameter. The shot struck a point 3 ft. from the bottom of the plate, and 3 ft. 8 in. from the left end looking at it. The effects were as follows: The shot cut a clean hole, passing through both plates, and breaking up during penetration, turned rather to the left, the point reaching a depth of nearly 10 ft., measuring from the front face of the iron. The plates behaved admirably, the hole being cut almost without any apparent effect in the surrounding portion of the plate. The wood was driven outward, 5 in. of the ends of the horizontal plates being thrust out beyond the plate at the left end, and 3 inches on the right. The granite was pulverized all round the projectile for some distance. Cracks were visible in the granite in front, as shown in Fig. 4. They will be observed to radiate from the point of impact, speaking generally. The stones of the course through which the shot passed are, like the layers of wood, forced longitudinally, left and right, projecting 3 in. beyond the other at each end of the squares of masonry. One or two cracks also were visible in the brick-work lining of the small cross passage behind the part struck. The bolts do not appear to have suffered, and the general structure shows little effect beyond what is here mentioned.

The experiment must be looked upon as highly satisfactory. A velocity of 1,100 feet ought to be sufficient to enable this projectile to perforate 16 in. of iron alone. Backed with granite, the resistance would be considerably greater. Suppose we guess that of the iron itself thus backed as equal even to 18 in. of iron, the velocity for that would only be about 1,200 ft., involving about 16,970 foot-tons of energy, leaving the shot to attack the granite behind with 12,760 foot-tons left in it. It is difficult to conceive of iron plates acting better than these on this occasion. The shot having passed rather to the left, has left the right hand portion of the plate as fit to receive another blow as could be expected. It will be interesting to see how the steel faced plates behave. In armor trials it is dangerous to give opinions beforehand, but we may expect more effect on the harder plate and less penetration in the masonry behind it, than in the case of the wrought iron. Plate and shot are both likely to suffer more under the increased suddenness of the shock against the hard steel, though the degree in which so comparatively thin a steel face tells on so big a shot may not be very great. We should expect the wrought iron covered portion under these precise conditions to do better than that with the steel-faced plate, even supported as it is, because the latter plate itself is more likely to suffer and leave the target weaker for future blows. If filled shell are fired, the case may be different. A shell has a better chance of getting its charge to act behind the plates of the sandwich shield than the thick steel faced one, but we do not know enough results of experiments with live shell to hazard an opinion as to whether either will suffer in this way. With first rate steel shell, we should be inclined to back the steel-faced plate.

The trial is satisfactory in more than one way. England is the only power that has employed wrought iron to any considerable extent in coast forts, chilled cast iron having come in generally abroad. An experiment therefore that shows that wrought iron behaves well is specially satisfactory to us as a nation, and in our judgment this is the case here. The iron has offered a great resistance, and it has suffered only locally. The latter is of course important as affecting the further powers of resistance of the fort. A shield to resist repeated blows of the 80-ton gun shot must of course be exceptionally strong. When it yields it is desirable to yield locally, and to leave still a good front protection.

We question if this plate has lost much in resisting power except in close proximity to the hole made in it. As we have before now pointed out, the plate-upon-plate system admits of being added to indefinitely, and thus it can be made to grow as it were in proportion to the increasing powers of guns. How chilled iron would behave under similar conditions is a question to which we can only form a reply on conjecture. It is supposed generally that it would suffer but little for a long time from the impact of shot that do not outmatch it, but it is thought that when completely outmatched it would be shattered *en masse*, instead of allowing a projectile to pass through it as wrought iron does, leaving a perforated, but in other respects a sound front plate, as illustrated in the experiment before us. Then comes the question again of steel shells carrying bursting charges, and whether such projectiles, if developed successfully, will not have the effect of bringing in the harder classes of armor. Once more we would urge the desirability of firing against chilled iron in this country, in order that we may know something about it for ourselves. If our ships ever engage a foreign iron fort, it can hardly fail to be one of chilled iron. We need experiments to learn even the relative effects of shot from small bore new type guns, and of those from old-fashioned ones with less penetrative power but more stored-up work in their shot. At present all this is matter of conjecture. About the value of the experiments now being conducted at Shoeburyness, there cannot, at all events, be two opinions.



ARMOR PLATE FORT AT SHOEBURYNESS.

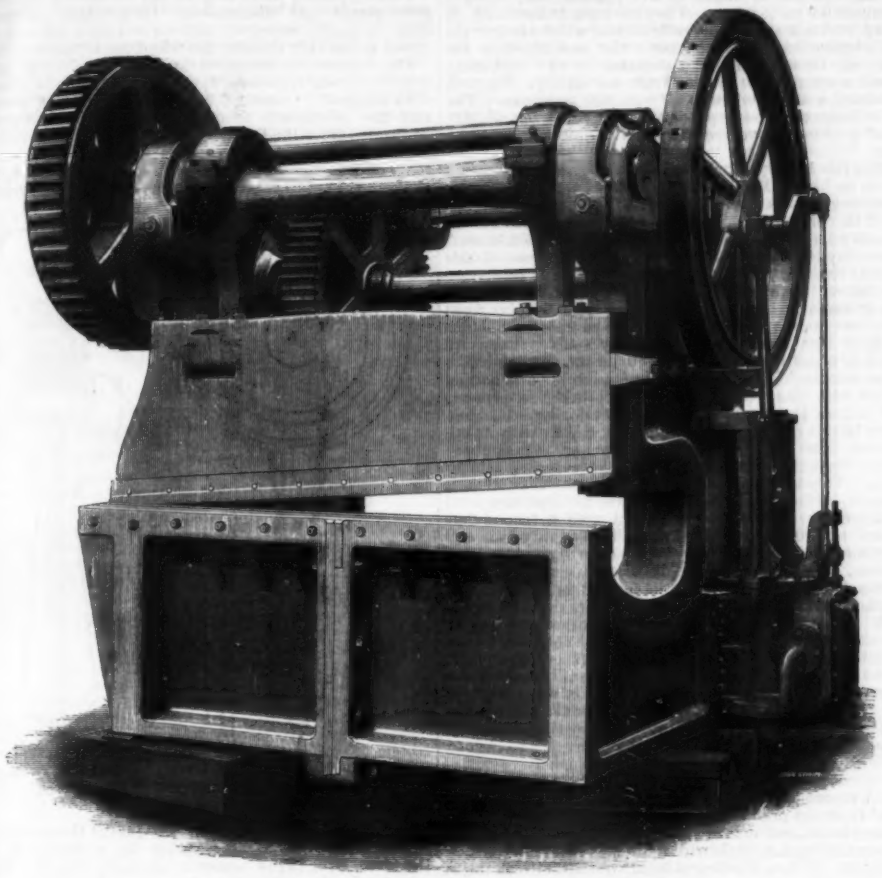
A CROP OF SEVEN MILLIONS OF COTTON BALES.

IT used to be thought before the war by many good people, both at the North and South, that the institution of human slavery was essential to the success of cotton growing, and if the slaves were set free all our cotton lands would go to grass. But free labor proves by far superior. The cotton crop for 1883 is the largest ever grown, and reaches seven millions of bales, against an average of three and a half millions of bales per annum for the five years prior to the war when slavery was flourishing and profitable.

LARGE PLATE SHEARING MACHINE.

THE accompanying illustration is from a photograph of a plate shearing machine of exceptional size and power recently constructed by Messrs. De Bergue & Co., Strangeways Ironworks, Manchester, for a foreign government dockyard. The machine, though simple in its construction, presents several features of interest. In machines of this class the ordinary arrangement is to cast the main standards separately, and to bolt between them the bottom cutter block, the whole being then either mounted upon a separate cast iron base plate, or the bolted frame bedded upon massive masonry foundations; but in the machine of which we give an illustration all foundations may be dispensed with, as each half of the bottom cutter block and base behind is cast with its corresponding side standard in one piece. The two halves of the machine are united by turned bolts at the front, as shown, as well as behind the block, where the flanges are widened out, so as to fill in the angle formed by the junction of the vertical block with the base plate. The back flanges thus serve as struts, imparting to the bottom cutter block additional rigidity, which is of so much importance in machines of extra width. In this case the cutters are 10 ft. 7 in. long, and the clear distance between the standards is 7 ft. 6 in. By the arrangement shown, of making the cutter slide overlap the faces of the main standards, large wearing surfaces and a firm bearing of the slide against the standards are secured, and at the same time the machine is enabled to effect the cross-cutting of a plate the maximum width between the standards with a minimum of distance between the standards themselves. In other words, the full length and stroke of the cutters are available, while the main standards are placed the minimum distance apart. The gap or distance from the face of the cutters to the main frame is in this machine 36 in. The main eccentric shaft is of steel, and has a throw of 8 in., the wheel on this shaft having a 4 in. pitch.

By a simple wedge adjustment the bearings of this shaft can be readily tightened at any time, so that wear is provided against, and the certainty of the top cutter always descending true and square upon its work is practically secured. A simple stop motion is also provided, so that the shearing action can be instantly arrested when required without stopping the machine; the handle for working this motion is shown on the illustration. The steam cylinder is 18 in. diameter, with 20 in. stroke, and is constructed of extra capacity to enable the machine to shear 1¼ in. plates, the longest and heaviest cut within the compass of the machine at one stroke. The total weight of the machine is thirty-three tons, and no little difficulty was experienced by the makers in delivering it at the destination, as none of the French railways could undertake the transport of the large castings. The machine had, in consequence, to be sent by sea, and this could only be effected by transshipment at an intermediate port.—*The Engineer.*



LARGE PLATE SHEARING MACHINE.

IMPROVED AUTOMATIC LATHE.

AN improved universal automatic lathe, which has lately been patented by Messrs. Heyne Brothers, of Offenbach-on-the Main, Germany, is represented by the annexed engravings. It is designed to cut screws of all kinds, and turn small articles in large quantities. The machine works continuously and automatically; it draws in the rod or bar from which it is working sufficiently to form the next article the moment the preceding one is finished. As the machine can be made to operate with three cutters of any shape and size, besides a screw cutting or boring device, a turned object of any shape or a screw of any sort can be produced. One of its great advantages lies in its automatically altering the speed at which it runs while the different operations are in progress; thus by an ingenious arrangement of mechanism the thread is chased on a screw at a much lower speed than that at which the same screw is turned and cut off. The value of this will be seen at once by all practical men, as when work is being turned it can be run at a much higher speed than when it is being threaded. Another feature of the invention is a safety arrangement, whereby all jamming and injury to the mechanism is avoided, should the metal which is being operated upon give way. The lubricant employed is filtered and pumped up to be reused over and over again. The inventors have now over thirty of these machines at work in their own shops, where it has been found that one man can serve five machines with ease.

The apparatus comprises a central rotating hollow headstock, E, through which the rod to be cut into screws is fed; a poppet headstock, N, carrying screwing dies in its nose; a turning tool on the arm, b^1, and cutting off tool on the arm, b. The headstock is provided with three grooved pulleys, one of which, P, can be connected to and disconnected from it by a friction coupling operated by the cam, G, driving it rapidly in one direction, while the turning operation is in progress; a second pulley, P^1, serves to drive the headstock slowly while the article is being screwed, while the third pulley drives it rapidly in the reverse direction to withdraw the screw from the dies. The wire or rod, X, after being inserted in the mandrel, is nipped by a pair of internal claws in the ring, R, operated by the cam, F, and then the ring and claws are moved bodily forward along the

Fig. 1

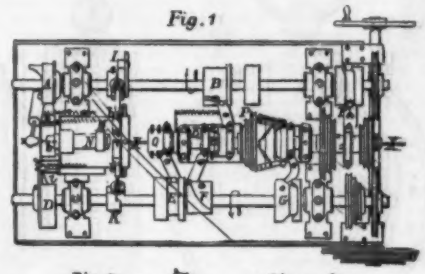


Fig. 2.

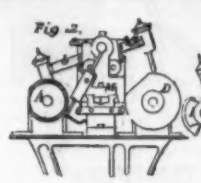
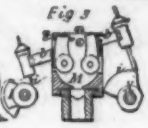


Fig. 3



mandrel by the cam, B, the exact length of the screw desired, carrying with them the rod. The chuck, Q, is now brought into action by the cam, E^1, and takes a firm grip on the rod, whereupon the ring and claws, R, leave hold and move back. The cam, K, then acts upon the rod, i, of the turning apparatus, b^1, and the chisel is brought to bear upon the wire at the same time the slide rest, M, through the action of the cam, D, is shifted forward, carrying the turning tool for a certain length, which is regulated by the beveled parts of the cam, D, and the segment of the cam, K. When the turning is completed, the speed of rotation is reduced as explained above, and the spindle, N, of the poppet forced up by the cam, A, until the dies engage with the rod to screw it, and cut it for the desired length. The mandrel is again reversed and the dies drawn off by a spring, and finally the cam, I, forces up the cutting tool and severs the finished article.

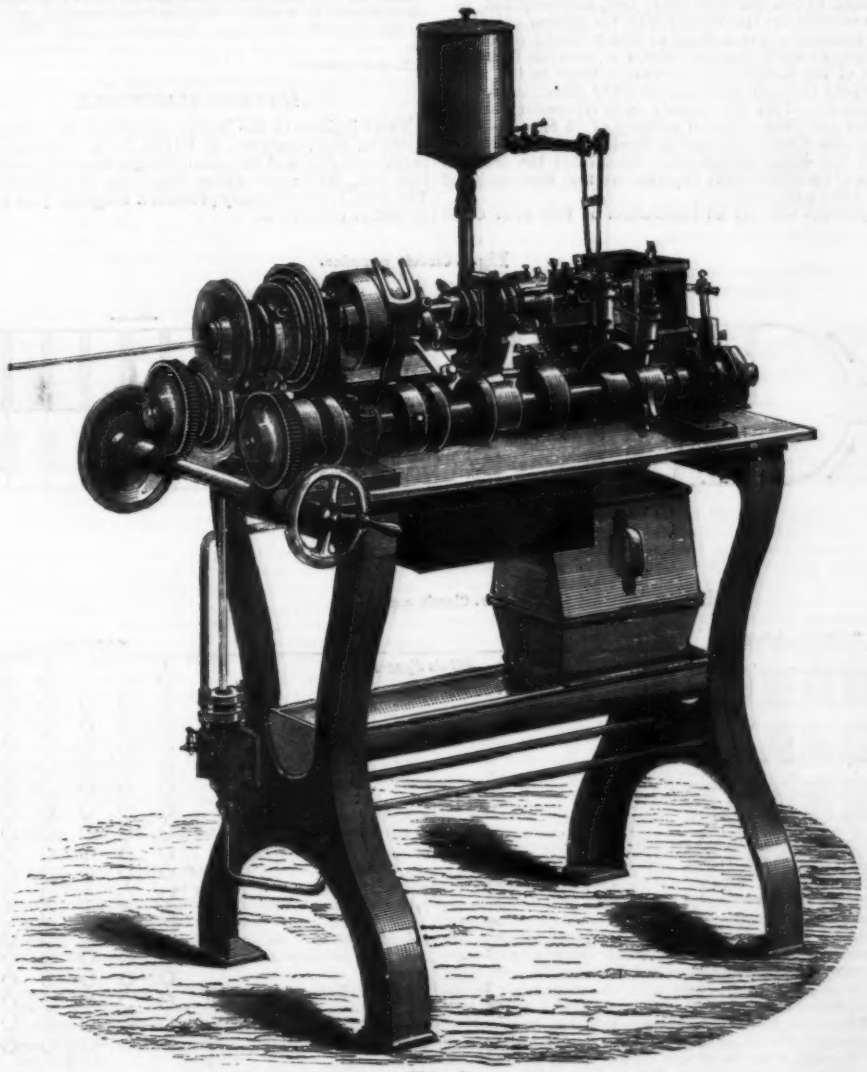


FIG. 4.

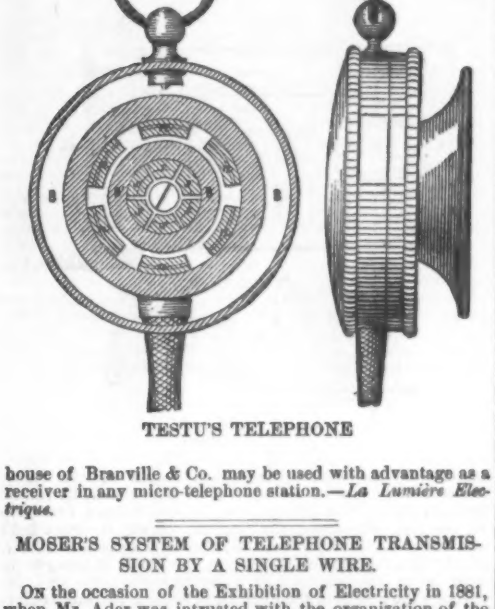
HEYNE'S UNIVERSAL AUTOMATIC LATHE.

TESTU'S TELEPHONE.

MR. TESTU, an employe of the Administration of Post-Offices and Telegraphs, has devised a magnetic telephone which, for several months past, has been giving excellent results.

Externally, this apparatus presents the form of a strong watch for whose crystal there is substituted an ebonite mouthpiece. The iron disk vibrates in front of a double magnetic ring having projections and interruptions, and being in form like two concentric watch cases with indented rims. The magnetic polarities vary from one ring to the other. Each of them receives a fine wire bobbin, so that the entire magnetic field is traversed by the circuit.

The model represented herewith as constructed by the



TESTU'S TELEPHONE

house of Branville & Co. may be used with advantage as a receiver in any micro-telephone station.—*La Lumière Electrique.*

MOSER'S SYSTEM OF TELEPHONE TRANSMISSION BY A SINGLE WIRE.

ON the occasion of the Exhibition of Electricity in 1881, when Mr Ader was intrusted with the organization of the telephonic auditions at the Opera, he placed 24 transmitters along the footlights (12 on each side of the prompter's box) and connected each of them with receivers placed in the halls of the Palais de l'Industrie, at about 2 kilometers distance. The first question that presented itself was: "How many receivers can be used with a single transmitter?" After several experiments, the number decided upon was four. Since, in order to hear well, it is necessary to put one receiver to each ear, it resulted that each transmitter could send sound to two auditors only; and, as it required two wires to connect the transmitter with the system of receivers, the conclusion was arrived at that it would require as many wires as there were auditors, *i. e.*, 48 wires for the 48 auditors of the Exhibition who were to listen to the music of the opera through the 24 transmitters placed in front of the footlights. This was not all; each transmitter had its Leclanché pile that consisted actually of 15 elements, thus requiring 360 elements for the 24 transmitters. So 360 pile elements and 48 wires were what constituted the material expenses of these beautiful experiments that were attended with so great a success.

The question whether an installation of this kind could not be rendered simpler and less costly, has been solved by Mr. Moser in a reduction of the piles and wires to a unity. Mr. Moser's system consists of a certain grouping of the microphones and bobbins, which he calls *batteries*, and which are two in number. The battery of *microphones* consists of 25 Ader microphones arranged in five parallel rows upon a board about 0·9 m. × 0·7 m. They are united electrically in quantity, that is to say, all the carbons into which the current enters communicate with the same wire starting from the pile, and all those from which it makes its exit communicate with a second wire starting from the battery. There is thus formed a single microphone with 300 terminals. The board is designed to be suspended by four cords, in a slightly inclined position above the orchestra of musicians, or in a theater.

Besides this battery of microphones designed for allowing music to be heard, Mr. Moser has devised another one for transmitting the voice, and the dimensions of which are half those of the preceding. It consists of a board that likewise carries 25 microphones placed under a single "membrane," that is to say, thin piece of fir wood. It is in front of this latter that the speaking is done or a newspaper is read.

The battery of microphones is always connected with the *battery of bobbins*, which consists of 24 double bobbins fixed in two rows upon a second board. The 24 internal bobbins with their iron cores are the primary ones. They are grouped in quantity and communicate on the one hand with the wire starting from the battery of microphones, and on the other with the second pole of the pile. The *primary circuit* is thus closed about as we have said, save that each primary bobbin does not communicate isolatedly with its microphone. The entire system of microphones is in communication, through a single wire, with the entire system of bobbins. This is an advantageous combination in that it eliminates the inconvenience of defective microphones.

Each primary bobbin is surrounded with a second fine wire one of 300 ohms resistance. These twenty-four secondary bobbins are grouped by sixes in quantity and by fours in tension. There issue, then, six wires on each side. The six through which the current enters end in the first line wire, and the six through which it makes its exit end in the second. These two wires, for one of which the earth may be substituted, lead the induction currents to the receivers in the auditorium. Here these wires are attached to receivers grouped in the same manner—six in quantity and four in tension—that is to say, they divide into six wires, each of which supplies 4 × 4 or 16 receivers, or 96 in all. This number has sometimes been carried up to 108 by the addition of two receivers to each series of tensions.

EXPLANATION OF THE FIGURES.

Fig. 1 represents the primary or inducing circuit. The current from the pile distributes itself equally between the 24 microphones, and makes its exit from the battery of microphones through a single wire that leads it into the battery of bobbins. It then distributes itself equally between the 24 primary bobbins and returns to the pile.

Fig. 2 represents the secondary or induced circuit. This comprises 24 induced bobbins, which it is necessary to suppose strung upon the primary bobbins of the first circuit so as to constitute together the battery of bobbins. These induced bobbins are grouped by sixes in quantity and fours in tension. This system communicates on the one hand with the earth, and on the other, through the line wire, with the system of 108 telephones grouped by sixes in quantity and by eighteens in tension. The induced current, on making its exit from the telephones, goes to the earth. The ground wire may be replaced by a return wire.—*Bulletin de la Soc. d' Encouragement.*

LIPPENS' TELEPHONE.

THE telephone of the Messrs. Lippens is an apparatus in which an electro-magnet, E F (Fig. 1), is substituted for a permanent one, and the core of which carries a cylindrical iron box, BB, upon whose edges rests the vibrating disk. The disk, I, consequently presents a magnetic pole contrary to that of the core, E.

FIG. 1.—LIPPENS' TELEPHONE.

At each station there is pile, but the two piles are connected with each other through the intermedium of the earth, so as to form but a single one, each of whose poles communicates with one of the two telephones connected by the line wire.

This telephone, according to the inventors, speaks with great power and distinctness. Its principle permits, besides, of readily arranging stations so that a call may be effected at the very moment the telephone is taken in hand.

Fig. 2 shows the arrangement of a station. The call-bell is put upon the terminals, G and H; the line is connected with terminal 1; terminal 2 is connected with the earth; and the telephone, mounted upon terminals 4 and 5, is suspended from the lever, B. In this position the spring, D, that the latter carries presses against E, and every current coming through the line enters through 1, passes at G H into the bell, and returns through 2 to the earth. The bell rings under the action of the pile at the other station. At this latter, the operator having his telephone in hand, the lever, B, is in the position shown in Fig. 2. The current coming from the pile enters, then, through 3, traverses the telephone at 4, 5, reaches F, and, through D, I, and 1, enters the line. It is, then, through the act alone of taking his telephone in hand that the operator gets the attention of his correspondent. Besides, as the current traverses the telephone of him who calls the interruptions of the bell produce a noise therein that apprizes him of the proper working of the apparatus at the other station, and the cessation of which makes known that the correspondent has taken his telephone in hand.

At this moment the two posts are in the position shown in Fig. 2, the current is no longer passing except into the two telephones, and the two piles, united into one by the earth and the ground wires of terminals 2, no longer come into play.

The two telephones once suspended anew from their

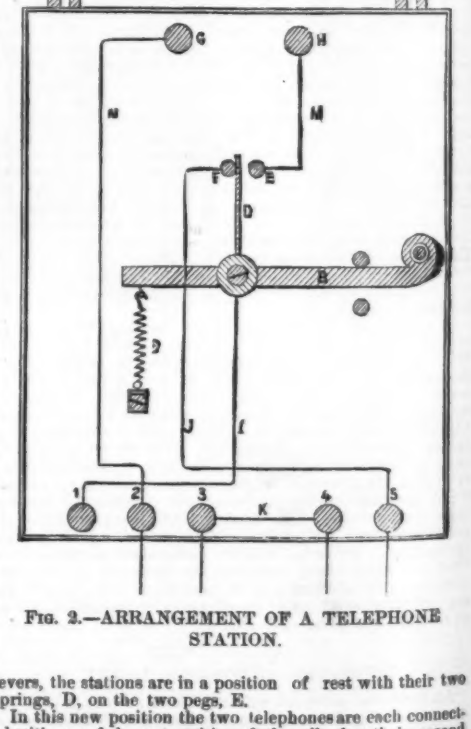


FIG. 2.—ARRANGEMENT OF A TELEPHONE STATION.

levers, the stations are in a position of rest with their two springs, D, on the two pegs, E.

In this new position the two telephones are each connected with one of the extremities of the pile, but their second wire is completely insulated. The line communicates then only with the two bells connected on another hand with the earth through the two ground wires of the terminals 2.

Each bell, therefore, is ready to ring as soon as, on taking up the telephone at the other station, a current is sent into the line from the pile at such station.

We do not know how much stronger and distincter this apparatus is than permanent magnet telephone, but it certainly possesses one signal advantage, and that is that the call is rendered automatic through the very action of seizing the telephone, and that the presence of the correspondent is announced automatically.—*La Lumière Electrique.*

Fig. 1. Circuit primaire.

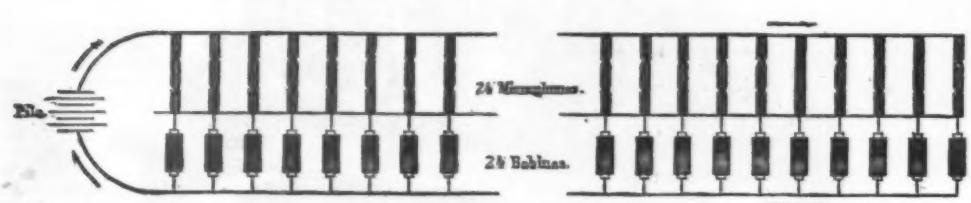


Fig. 2. Circuit secondaire.

MOSER'S SYSTEM OF TELEPHONE TRANSMISSION BY A SINGLE WIRE.

KABATH'S SYSTEM OF LIGHTING RAILROAD COACHES BY ELECTRICITY.

AROUND the aperture in the car made to receive the oil lamp there is placed a ring of rubber or some other insulating material to serve as a seat for the electric lamp properly so called, a part of which latter is confined in the glass globe, *a* (Fig. 1), that projects into each compartment. This electric lamp consists of two copper conducting plates, *b*, which form a seat and are connected with a partitioned receptacle, *c*, that contains a group of accumulators united in tension, and the number of which is proportioned to the distance between the charging stations and to the duration of the lighting. At the base of the partitioned receptacle there is an

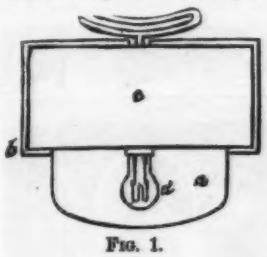


FIG. 1.

ordinary incandescent lamp, *d*, which is connected with the two poles of the accumulators by copper wires. The lamp current may, at will, be established or interrupted by means of an ordinary commutator, *e*, having the form of a key. Such is, in principle, the arrangement of Mr. Kabath's invention.

It is proposed that there shall be electric lamp stations established at proper places along the route, in which the accumulators may be charged. These stations may be established in any sort of structure, under a shed, for example, where the dynamo-electric machines, *m*, and the accumulators, *n*, are placed. (Fig. 2.) At each charging station the electric lamps will be removed from the compartments and placed upon a lamp car like those now in use, but one whose upper part in contact with the conducting part of the lamp will be rendered non-conducting by a plate of some insulating material or other. The lamps, on reaching the charging station, will be placed upon two copper plates in such a way that their copper conductors are in contact therewith, the plates themselves being connected with the station accumulators. (Fig 2.) These latter will be stationary and

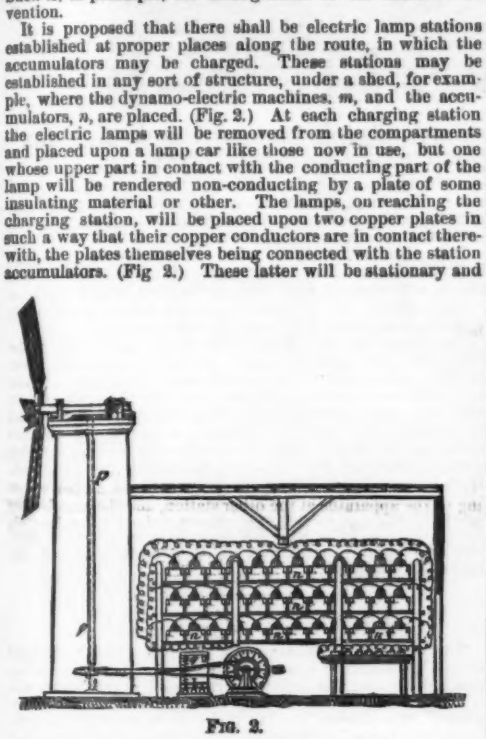


FIG. 2.

of great weight, and will be continuously receiving a charge from the dynamo-electric motor. Mr. Kabath proposes also to apply to his system a windmill, *p*, for actuating the dynamo.

In order to prevent a change of poles through irregularities of action in the wind motor, the inventor would place between the dynamo and accumulators an automatic "disconnector and connector," *q*. The electric lamps, having been charged by their more or less prolonged contact with the copper plates of the electric lamp station, will be placed upon the car, and carried to the coaches in order to be put in place. The lamps are lighted by acting upon the commutator so as to close the circuit.

[NATURE.]

ON THE PROPERTIES OF WATER AND ICE.*

DR. PETTERSON'S memoir is a most valuable contribution to our knowledge of the natural history of the waters of the globe. Every reader of Arctic voyages must be familiar with the variety of names attached to the different kinds of ice met with in these regions, such as "pack ice," "bay ice," "brash ice," and the like. To one who has never seen them, the names convey very little information either of their appearance or of their mode of formation. Dr. Petterson's paper explains in a satisfactory and very remarkable manner the nature of the difference between the different kinds of ice.

In the first part of the work the subject is treated physically, and in the second chemically. In both parts there is much that is new and valuable.

In the Arctic Ocean, and especially in that part of it visited by the *Vega*, the saltness of the water varies much from place to place. The large rivers of Siberia constantly pour forth fresh water, which lies on the surface of the ocean and spreads round the coast like a fringe. This layer often extends a considerable distance out to sea, where it gradually thins out. Nearer the shore it is thicker, but wherever the depth exceeds 20 or 30 meters the dense ocean water is found below, and the two layers persist without sensible mixture. As an example may be cited some observations made on board the *Willem Barents* in the Kara Sea on August 3, 1881:

Depth, fathoms.	Temp. ° C.	Density.
0	+8·2	1·006
1	+6·2	1·009
2	+1·7	1·020
3	−1·0	1·0236
5	−1·5	1·0247

Here, while we have what is practically fresh warm water at the surface, and to a depth of a fathom from it, at two fathoms we have cold Arctic Ocean water. Looking therefore to the great variety in the composition of the waters exposed to the winter cold and therefore likely to produce the ice met with in Arctic regions, Dr. Petterson has studied separately the change of heat and volume by the freezing of (1) pure water, (2) brackish water of little saltness, and (3) ocean water of ordinary saltness. With regard to the freezing of brackish or salt water no previous investigations of a quantitative character exist, and the author's results are all new. With regard to the freezing of pure water the most important investigations were those of Plücker and Geissler. While verifying their result as to the *average* coefficient of dilatation of ice, the author made the important discovery that the volume of ice *decreases* as the temperature rises, in the vicinity of the melting point. In extending his researches to brackish and salt waters he found this anomaly more and more accentuated the more salt was contained in the ice formed. Rightly seizing the importance of this very remarkable observation, the author makes the behavior of pure ice in the vicinity of its melting point one of the main objects of the investigation. The "dilatometer" used was a glass vessel of peculiar construction and of a capacity of 41 cubic centimeters. The water to be experimented on was frozen in it, so that it formed a cylinder of ice surrounded by mercury, which extended also into a capillary tube and indicated changes of volume. As the accuracy of the results depends, among other things, on the correctness of the determinations of the absolute dilatability of mercury, and as this is somewhat uncertain, and indeed variable, at low temperatures, the author adopted the device of Plücker and Geissler for producing a practically undilatable envelope for his experimental substance. The principle of it is very simple. The envelope is of glass with a coefficient of expansion 0·000028; that of mercury is 0·000181. If the volume of the glass envelope is to that of the mercury contained in it in the inverse proportion of their coefficients of expansion, the residual volume will be constant even though the temperature vary. If the volume at 0° C. of the glass be 18·1 c. c. and that of the mercury 2·8 c. c., the residual volume is 18·1−2·8=15·3 c. c. If the temperature is *t*°, the volume of the glass is 18·1 (1+0·0000280) and that of the mercury 2·8 (1+0·0001810), and the residual volume is *v*=18·1−2·8 as before. The effect of variation in the coefficient of expansion of the mercury is thus reduced to a minimum.

When a cylinder of ice had been frozen in the instrument, it was immersed in a mercury bath, and subjected to variations of temperature, either with freezing mixtures, or, in winter, by exposure to the atmosphere.

These series of experiments were made with distilled water. The first series was made with water taken from the store jar in the laboratory. It gave a slight opalescence with nitrate of silver, and cannot therefore claim to have been pure. The ice formed by its congelation expanded with rise of temperature from −30° C. to −0·3° C. Here it began to contract until it melted at 0° C. Two other series of experiments were made with water repeatedly distilled. The ice from it did not begin to contract till the temperature had risen to −0·03° C.

There can be no doubt, especially in view of later experiments with brackish waters, that the not chemically pure distilled water did contract at a measurable distance from its melting point. With regard to the other two samples, the temperature at which the ice began to expand with heat is so close to its actual melting point, that it is impossible to have implicit reliance in the result claimed. The author's own view will be best judged from the following paragraph (p. 282):

"It is impossible to decide if absolutely pure water would be entirely free from this weakness or not, since we cannot assume that water which has boiled for a quarter of an hour or more in a glass vessel is absolutely free from minimal quantities of foreign substances, as, for example, sodium salts, silica, etc. For my own part I am rather inclined to think that absolutely pure water, if it could be tested, would show an absolutely fixed melting point, but I think that this problem very much resembles another question still undecided, viz., is absolutely pure water a conducting or non-conducting substance for electricity?"

It would be well to repeat the experiment with pure freshly distilled water, freeing it from air by boiling *in vacuo*, which Dr. Petterson's apparatus would easily admit of. There would then be very much less risk of the glass being attacked.

Experiments made with sea-water ice proved that the property of contracting with heat, as the melting point is reached, becomes more and more marked the greater the quantity of salt in the ice. Three series of experiments were made. In the first, the ice when melted had a specific gravity of 1·0003, and contained 0·014 per cent. chlorine. It began to contract at −4° C. The second had a specific gravity of 1·00534, and contained 0·273 per cent. chlorine. It began to contract at −14° C. The third had a specific gravity of 1·0094, and contained 0·649 per cent. chlorine. It was contracting at the lowest observed temperature, −19° C.

In connection with these remarkable results it must be mentioned that at the same temperature, as, for instance, −15° C., the volume of the ice which on being melted furnishes 1 c. c. water at 0° C. is less the greater the amount of salt contained in it. Sea water being an exceedingly complex body, it is to be hoped that Dr. Petterson will extend his research so as to examine in the same direction the ice formed by simple solutions of each of the more important ingredients of sea water. How different ice produced by the freezing of sea water must be from what we are accustomed to see on our lakes and ponds in winter, will be evident when we read (p. 286): " . . . The new ice which arises by sudden freezing of the calm surface of the Arctic sea is a *tough* substance, which can be wrinkled and folded by external pressure without breaking. Although it may be thick enough to bear the weight of a man, it is so plastic that a footstep makes a deep impression, as in mouldable clay."

The physical part of the work closes with the investigation of the latent heat of fusion of fresh and salt ice. The result is that "the latent heat developed by the freezing of sea water is *extraordinarily inferior to that of pure water*."

Hardly less interesting than his physical experiments, are the investigations into the chemical composition of sea-water ice.

It has been very generally believed that sea-water ice owes its salinity to mechanically entangled brine, and that all that is really solid in it is pure ice. Scoresby, probably the most acute observer among Arctic voyagers, referring to this subject, says:*

"Although I have never been able to obtain from the water of the ocean, by experiment, an ice either compact, transparent, or fresh, yet it is very probable that the retention of salt in ice may arise from sea water contained in its pores; and, in confirmation of this opinion, it may be stated that if the newest and most porous ice be removed into the air, allowed to drain for some time in a temperature of 32° or upward, and then be washed in fresh water, it will be found to be nearly quite free from salt, and the water produced from it may be drunk."

During the Antarctic cruise of the *Challenger* the writer of this notice made some experiments to decide the question whether or not sea-water ice is a mixture of pure ice and sea water or brine. The *melting point* of salt-water ice of various sources was carefully observed, with the following results. Ice formed in a bucket of sea water over night melted at −1·8° C. The bulk of ice formed was insignificant compared to the volume of water in which it was formed, so that this was a specimen of *bona fide* sea-water ice, without admixture of snow or spray. In the same way the melting point of pack-ice was determined. The freshly collected ice began to melt at −1° C.; after twenty minutes the thermometer had risen to −0·9°, and two hours and a half afterward it stood at −0·8°, having remained constant for about an hour at −0·4°. Another portion of the ice rose more rapidly in temperature, and when three-fourths of the ice was melted, the thermometer stood at 0° C. In the case of the ice frozen in the bucket, the melting point remained constant for twenty minutes at −1·8°, after which no observations were made, so that we do not know if this ice, formed under the most favorable circumstances, showed the same irregularities as the pack-ice, picked up out of the sea; but as the bulk of ice experimented on did not much exceed 10 cubic centimeters, the greater part of it must have melted in the twenty minutes. Indeed, as the amount of ice formed in the bucket did not sensibly alter the composition of the water left liquid, there seems to be no reason why the ice should not be a homogeneous substance.

Adhering brine can have no influence on the melting point of ice, consequently, if sea-water ice consists of pure ice with entangled brine, it must melt at 0° C. If its melting point is different from 0° C., then the solid matter of the ice is not pure ice. We have seen that frozen sea water has a melting point of −1·8°, which is fairly constant, and that pack-ice, which must necessarily be formed by the freezing of salt water, the congealing of spray, and the accumulation of snow, begins to melt about −1°, the temperature gradually rising as the constituents of lower melting point are liquefied. It is thus readily apparent how it is that Scoresby found that such ice "allowed to drain for some time in a temperature of 32° or upward," produced in the end potable water. The salt-water ice of low melting point effectually prevents the intermingled snow from melting, which finally remains practically intact, and of course can be drunk on being melted.

Dr. Petterson on purely chemical grounds comes to the same conclusion. He says (p. 303): "Those who support the common theory that sea ice is in itself wholly destitute of salt, and only mechanically incloses a certain quantity of unfrozen and concentrated sea water, must confess that we in this case ought to find by chemical analysis exactly the same proportion between Cl, MgO, CaO, SO_3, etc., in the ice and in the brine as in the sea water itself." That this is not the case is shown by a number of analyses of sea-water ices in which the proportion of Cl: SO_3 varied from 100: 12·8 to 100: 76·6, the average proportion in sea water being 100: 11·88. The results of his investigations may be summarized as follows:

Ocean water is divided by freezing into two saliniferous parts, one liquid and one solid, which are of different chemical compositions. Taking the relation Cl: SO_3 as standard of comparison, the most striking feature of the freezing process is that the ice is richer in sulphates, and the brine in chlorides. The extraordinary variation, both in saltness and in chemical composition, of every individual specimen of sea ice and sea brine, shown by the tables, depends on a secondary process, by which the ice seems to give up its chlorides more and more, but to retain its sulphates. Hence the percentage of chlorine is no indication of the saltness of the ice, though it may to a certain extent be taken as an index of its age.

In connection with this part of the subject, the author cites Prof. Guthrie's work on cryohydrates, and gives the following table:

Cryohydrate of	Contains		Solidifies at
NaCl	76·39 per cent.	water	−22° C.
KCl	80·00	"	−11·4° C.
$CaCl_2$	73·00	"	−37° C.
$MgSO_4$	78·14	"	− 5 0° C.
Na_2SO_4	95·45	"	− 0·7° C.

Supposing that these cryohydrates are formed in the freezing of sea water, it is easy to see how, as the temperature rises, the chlorides melt out first and leave the ice richer and richer in sulphates.

Before concluding this notice, attention must be called to a statement in a note at the foot of p. 318: "As a thermometer immersed in a mixture of snow and sea water, *which is constantly stirred*, indicates −1·8° C., we may regard," etc. This can be true only if the temperature of the atmosphere is −1·8° C.; if it is 0° C. or higher, the temperature of the sea water will assuredly rise to the melting temperature of snow, or 0° C.

Even though it should turn out that chemically pure ice does, as the author suspects, melt suddenly without previous contraction *as ice*, the discovery of the existence of a *minimum density point* of ice, not chemically pure, which includes all the ice on the globe, is one of the very highest importance.

It is to be hoped that we shall soon have a further installment of work on a subject so large and so important, and with which the author has shown himself so well qualified to deal.

J. Y. BUCHANAN.

COKE LOCOMOTIVES.—The new Illinois law, requiring the use of devices to prevent the smoke nuisance, has brought out a coke locomotive. One of these engines was brought into notice by its performance on the Chicago, Burlington, and Quincy Railroad during the Chicago Exposition. The tests demonstrated that runs of 200 miles can be made with coke fuel, without any further attention of the fireman than simply feeding the furnace, and that no clinker or obstruction to the draught occurred during the trials, which were of the most exacting nature. The coke used was the product of the Connellsville Coke and Iron Company, and its calorific efficiency was in excess of seven pounds of water evaporated for each pound of coke consumed. Coke used to be employed in all the early locomotives, and its readoption is very desirable.

* "On the Properties of Water and Ice." By Otto Petterson. Publication of the *Vega* Expedition. (Stockholm, 1883.)

* "An Account of the Arctic Regions," Edinburgh, 1820, vol. i., p. 120.

SCIENCE IN ANTIQUITY.

THE MACHINERY OF THE TEMPLES.

A. RICH, in his Dictionary of Roman and Grecian Antiquities, relates, under the word *Adytum*, that many ancient temples possessed chambers that were known only to the priests, and that served for the production of their prestiges. He was enabled to visit a perfectly preserved one of these at Alba, on Lake Fucino, in the ruins of a temple in which it had been formed under the *absis*, that is to say, under the large semicircular niche which usually held the image of the god at the extreme end of the edifice. "One part of this chamber," says he, "is sunk beneath the pavement of the principal part of the temple (*cella*), and the other rises above it. The latter, then, must have appeared to the worshipers assembled in the temple merely like a base that occupied the lower portion of the *absis*, and that was designed to hold in an elevated position the statue of the divinity whose name was borne by the edifice. This sanctuary, moreover, had no door or visible communication that opened into the body of the temple. Entrance therein was effected through a hidden door in an inclosure of walls at the rear end of the building. It was through this that the priests introduced themselves and their machines without being seen or recognized. But there is one remarkable fact, and one which proves without question the purpose of the *adytum*, and that is, that we find therein a number of tubes or hollow conduits which form a communication between this compartment and the interior of the temple, which end at the differents parts of the walls of the *cella*, and which thus allowed a voice to make itself heard at any place in the temple, while the person and the place whence the sound emanated remained hidden."

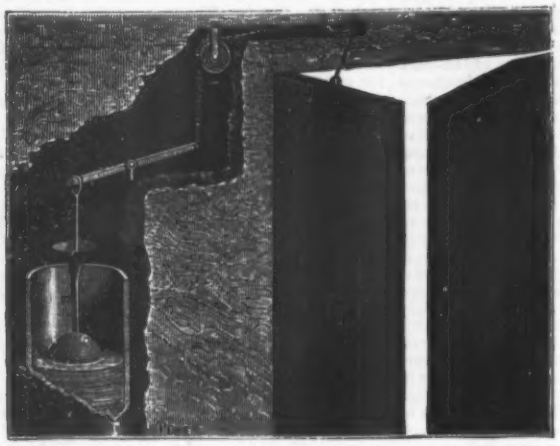


FIG. 1.—APPARATUS FOR SOUNDING A TRUMPET WHEN THE DOOR OF A TEMPLE WAS OPENED.

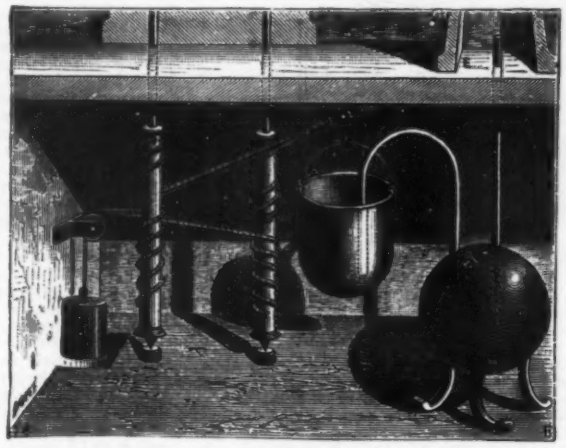


FIG. 2.—MECHANISM FOR OPENING AND CLOSING THE DOORS WHEN A FIRE WAS LIGHTED UPON THE ALTAR.

Sometimes the *adytum* was simply a chamber situated behind the *absis*, as in a small edifice which was still in existence at Rome in the sixteenth century, and a description of which has been left to us by Labbacco, an architect of that epoch.

Colonel Fain tells me that he himself has visited an ancient temple in Syria, in the interior of all the walls of which there had been formed narrow passages through which a man could make a tour of the building without being seen.

In the temple of Ceres, at Eleusis, the pavement of the *cella* is rough and much lower than the level of the adjacent portico; and, moreover, the side walls exhibit apertures and vertical and horizontal grooves whose purpose it is difficult to divine, but which served perhaps for the establishing of a movable flooring like that spoken of by Philostratus in the Life of Apollonius (lib. iii., ch. v.). "The sages of India," says he, "lead Apollonius toward the temple of their god, singing hymns on the way and forming a sacred procession. The earth, which they strike in cadence with their staves, moves like an agitated sea, and raises them to a height of nearly two paces, and then settles again and assumes its former level."

The statues of the gods, when they were of large dimensions, possessed cavities which the priests entered through hidden passages in order to deliver oracles (Theodoret, Hist. Eccl., vol. xxii.).

We read in Pausanias (Arcadica, lib. viii., ch. xvi) that at Jerusalem the tomb of a woman of the country, named Helen, had a door made of marble like the rest of the monument, and that this door opened of itself on a certain day of the year, and at a certain hour, by means of a machine, and closed again some time afterward. "At any other time," adds he, "had you desired to open it, you had sooner broken it."

According to Pliny (xxxvi.,14), the gates of the labyrinth of Thebes were so constituted that when they were opened they emitted a noise like that of thunder.

FIG. 3.—TEMPLE WHOSE DOORS OPENED WHEN A FIRE WAS LIGHTED UPON THE ALTAR.

Heron, in his Pneumatics, gives us an explanation of some of these prodigies.

Figure 1, which is entitled, "The following is the way in which the sound of a trumpet is produced when the door of a temple is opened," is sufficiently clear to permit me to dispense with a reproduction of the Greek engineer's text in this place. It will be seen that when the door is opened, a system of cords, guide-pulleys, and rods pushes into a vessel of water a hemisphere to the upper part of which a trumpet is fixed. The air compressed by the water escapes through the instrument and causes it to make a sound.

Figures 2 and 3 are likewise borrowed from Heron, and correspond to an apparatus that bears as its title: "Construction of a chapel such that, on lighting a fire, the doors open of themselves, and close when the fire is extinguished."

The altar is hollow, as shown at E, in Fig. 2. When fire is lighted thereon, the air contained in the interior dilates and presses against the water with which the globe situated beneath is filled. This water then runs through a bent tube into a sort of pail suspended from a cord that passes over a pulley, and afterward separates into two parts, and winds around two cylinders movable upon pivots, and forming a prolongation of the axes around which the doors revolve. Around the same cylinders are wound in opposite directions two other cords, which likewise unite into a single one before passing over a pulley, and then hanging vertically in order to hold a counterpoise.

It is clear that, when the water from the globe enters the pail, the weight of the latter will be thereby increased, and that it will descend and draw on the cord, which has been wound around the cylinders in such a way as to cause the doors to open when it is drawn in this direction.

The doors are afterward closed again as follows: The bent tube that puts the globe and pail in communication forms a siphon whose longer arm enters the globe. When the fire is extinguished upon the altar, the air contained in the latter and in the globe becomes cooled and diminished in volume. The water in the pail is then drawn into the globe, and the siphon, being thus naturally primed, operates until all the water in the pail has passed over into the globe. In measure as the pail lightens, it rises under the influence of the counterpoise; and the latter, in its descent, closes the doors through the intermedium of the cords wound around the cylinder. Heron says that mercury was sometimes used instead of water on account of its being heavier.—*A. De Rochas, in La Nature.*

THE TRANSVAAL GOLD LAW.

THE full text of the new law passed by the Volksraad of the Transvaal to regulate gold mining in that State has reached us; and the following *resume* of its provisions will be useful to intending "prospectors" in England and elsewhere. The absence of a law giving encouragement to individual enterprise has been one of the reasons for the neglect of the known rich deposits of gold in the Transvaal, and now that the State has declared that its policy will be to welcome new settlers, many experienced gold miners from Australia and elsewhere will no doubt be encouraged to take out licenses. The law begins by giving the President power to proclaim as a "gold field" any Government property on which gold may be found.

If gold in payable quantities is found on a private farm, the owner has the option of taking out, within six months, a concession for the exclusive right to work it. If he does not avail himself of this privilege, the Government may buy up his property at a price to be fixed by arbitration. A commissioner is to be appointed for every gold field, over which he will have authority to keep order and to deal with all matters arising out of the working of the mines. He will be assisted by a Diggers' Committee, to be elected by the license holders and the diggers, whose interests will thereby be fully protected. Every digger and license holder will be liable to be called upon to assist in maintaining order in case of necessity, under pain of forfeiture of the license or concession.

The cost of a license to dig or to prospect on Government ground is fixed at 10s. per month; for prospecting on private ground, with the consent of the owner, the same fee is payable, three-fourths of it to go to the owner. Only one claim can be taken out by a single individual; each claim to be 150 ft. square, the limits of which must be duly "beacoued" Any person, however, may buy from other claim holders any number of claims on taking out the proper license for each. The discovery of future gold fields is encouraged by giving any prospector who discovers gold in payable quantities 5 per cent. of the revenue which the Government may receive from such field.

This revenue will be derived from the sale of licenses, from a percentage of 2½ per cent. on all finds, and from a percentage of 4 per cent. on the purchase money on the sale of a claim. There is a curious provision that where the sum of £300 or more has been paid for a claim, or £500 or more for improvements or in the erection of machinery, and is abandoned, it shall still remain the property of the owner for a period of six months after abandonment. This provision is intended to allow the owner to reap the advantage of any discoveries which may be made within that period of reefs on adjoining claims, which might possibly prove to extend into his property.

The least satisfactory part of the law is that which enacts that "any colored person who sells, barters, delivers over, receives, or has in his possession rough gold shall be punished with lashes not exceeding 50 and be imprisoned for the term of not exceeding 12 months." It is also enacted that no colored person shall have the right to hold a license or be in any way connected with the working of the gold fields, except as laborers in service of the whites, who are pro-

hibited, under a penalty of £500 or a year's hard labor, from paying the colored servant in rough gold; and from buying rough gold from any colored person under a penalty of £1,000 or a year's imprisonment.—*London Times.*

THE HEROINE OF TEL-EL-KEBIR.

JUNO, the heroine of Tel-el-Kebir, is an Irish setter dog belonging to the 1st Battalion Gordon Highlanders. Her first master was Lieutenant-Colonel Vandeleur, and on his leaving the regiment, Juno, who was then serving in Malta, became the charge of a certain gallant sergeant, who, it is said, frequently shared his dinner with her. When the order came for Egypt, it was universally decided that Juno must accompany the regiment, and accordingly she went through all the vicissitudes of that campaign, even to the trenches of Arabi's famous stronghold. There, on the eventful day, a writer in *Land and Water* tells us, "she bravely 'rushed' the entrenchments at the head of the Highlanders, and inside displayed a coolness and a courage which elicited universal applause, no more minding the rain of bullets than if she were out snipe shooting. Whether she tackled the enemy we do not know; the rest we can vouch for. But even if her teeth did not meet in any Egyptian leg, her appearance must have spread consternation in the rebel ranks. Here they thought, no doubt, was one of the 2,000 bloodhounds which Sir Garnet Wolseley was credited with keeping in reserve, and the dauntless pluck exhibited by Juno must have duly impressed upon their timid minds the awful consequences which would befall them if they waited for the arrival of her 1,999 canine comrades. They did not wait, but bolted for their lives, with Private Juno snapping at their heels, and as the wave of war rolled forward, this glorious dog swept ever on its crest until its force was spent, and the Egyptian army was likewise spent. Such, then, was the gallant achievement which has endeared Private Juno to the Gordon Highlanders forever." Our engraving is from a photograph.—*London Graphic.*

A HEROINE OF TEL-EL-KEBIR.—THE REGIMENTAL DOG "JUNO."

SALT.

IT is, perhaps, a truism to assert that the heirs of the scientific results of former ages do not always "take" in a direct line. All knowledge necessarily owes much to collateral branches of the great family tree, and its advance has been oftener made by lonely by-ways than by any "royal road." Science, indeed—or at least that rather ambiguous phase of it which is now known as "popular"—has so filtered into the scheme of a modern scholastic course that we have juvenile professors at every breakfast table, able and willing to instruct their elders upon the chemistry of the teapot and the quartern loaf.

From the elders themselves, however, has been of late years evolved a class anxious to "go back" upon the steps of their ancestors. The enviable simplicity of primitive man is the ideal which these persons set before them, and this particular crotchet has already developed into several minor whimsies of more or less strength and significance. The teetotalers, of course, regard themselves as far in advance of any sect that could properly be comprised in such a description; but they have kindred in the vegetarians, the anti-tobacconists, and the crusaders against every denomination of sport; and it would seem that a new division of amiable enthusiasts are now prepared to do battle against the use of salt as an article of diet, and are proposing to themselves and to their neighbors to abstain from it henceforth. The probable stumbling-block in the way of this new profession will be the difficulty of finding "awful examples."

The history and the science of salt point convincingly to its almost universal use and to the benefits which have as universally resulted from it. Pliny, indeed, goes so far as to say that human nature cannot exist without salt, which is so much an element of life that, passing from bodily sensation, it became from a very remote antiquity a metaphorical term for the pleasures of the mind. Salt is agreeable to the palate, and is therefore transferred to the mental taste. It is synonymous with whatever presents itself as piquant, lively, or agreeable to our mental faculties. Its symbolical significance, is, indeed, almost coextensive with its practical use. By the Hebrews Greeks, and Romans it was held in such veneration that it formed an integral part of their sacrificial ceremonies, while the almost superstitious regard paid to the act of setting salt before a stranger had even a wider meaning, and is still regarded as the enactment of an inviolable pledge by nearly every Eastern nation. In this sense salt was the silent expression of the rites of hospitality, in which the common instincts of mankind had ever discovered a peculiar sanctity; and thus we find Cassandra aggravating the crime of Paris in stealing Helen on the ground that he has "contemned the salt and overturned the hospitable table."

But it is from the material uses of salt that its importance as a symbol has been derived. Some description of salt is almost universally diffused throughout the whole economy of nature, and in those portions of the globe in which it is a rarity it is treasured with a jealous care that affords a sufficient commentary upon the belief in its value.

In the interior of Africa it is still regarded as one of the greatest luxuries, and a child there sucks a piece of rock salt as if it were sugar. Mungo Park speaks of the long use of vegetable food among some of the tribes visited by him as creating "so painful a longing for salt, that no words could sufficiently describe it." In Abyssinia, likewise, salt was for a long time more expensive than the purest white sugar in Europe; and another traveler suggestively tells us that children there gather around their mother while engaged in any operation in which salt is employed.

Among the Western nations salt has from time immemorial been regarded as so vital a necessity that no controversy as to its relish or sanitary value was ever for a moment possible. It was used from the first in some such way as water, quite as a matter of course, and with a tacit acknowledgment that it was absolutely indispensable for man's existence. Medical science tells us that it occurs alike in every fluid and every solid, and in particular that it is a standing constituent of the blood, "which will take up so much and no more, however much we may take with our food; while if no salt be given, the blood parts with its normal quantity slowly and unwillingly." This proportion is not, therefore, necessarily sustained by each individual preference for more or less salt, although even those whose palates lead them to reject an appreciably large amount of the condiment would find it difficult to escape from its administration through the medium of many of the staple foods of civilized life. Thus, every adult unconsciously consumes about two ounces of salt per week in bread alone, and its necessity in this form may be appreciated by the light of a rather curious tradition, that the old method of executing criminals in Holland was to confine them solely to the use of bread in which no salt was contained, and which ultimately occasioned death by engendering a fatal form of disease.

The moral influences and associations of salt among the Europeans of the Middle Ages were naturally of a less exalted description than those of higher antiquity. They still, however, bear constant reference to the sacred rights of hospitality. The time-honored custom of placing a massive piece of plate, called the salt-vat, or "foot," on the middle of the table was one that formerly obtained in France as well as in England and Scotland, the guests being seated above or below the vessel according to their several ranks.

"Thou art a carle of mean degree;
Ye salt doth stande twain me and thee,"

says an old English ballad, though it is right to add that some antiquarian writers have rather questioned all that is usually implied in the phrase "below the salt." According to these critics, the sitting above or below the salt meant nothing more than having a place at the upper or lower end of the table, the relation which one's seat was said to bear to the salt being merely accidental, from the fact that the vessel containing it was the center object. Against this view, however, may be set the consideration that the folk-lore pertaining to salt is very various and abundant, while a kind of superstitious reverence for its emblematic efficacy is still common among the humbler classes of most nations. The Dutch see in an overturned salt-cellar the symbol of a shipwreck; and when salt happens to be spilt at table, they are by no means alone in the custom of taking up a pinch and throwing it over the shoulder to avert the ill luck which will otherwise certainly ensue. In some parts of England dairymaids still throw salt into the fire for luck before beginning to churn; while in not a few places a plate of salt is reverently laid upon the breast of a corpse awaiting burial, the ceremony in some remote districts preceding death, in order that the sick person may die more easily.

The various modes of obtaining and manufacturing salt are too well known to require description. Salt mines are in existence in Poland which have been worked for over 600 years, and the salt works of Cheshire were of importance in the time of the Saxon Heptarchy. The word "salary,' or *salarium*, which means salt-money, is, indeed, derivatively connected with the salt mines which the Romans worked at Droitwich and elsewhere.

From whatever point of view we regard the commodity known as "common salt," it is full of material for reflection. To go no higher, its social and symbolical, its medicinal and culinary values, have been approved of by tens of centuries of experience. Modern scientific authority certifies to its necessity and to the evils which would certainly ensue upon abstention from it. Such considerations have not, it is true, been ever strong enough to break down a determined "craze," upon however feeble a foundation it may have been laid. But it is to be hoped there is enough common sense in the country to prevail in the present instance against the tenets of the anti-salt community.—*London Globe.*

[PHILADELPHIA LEDGER.]

LIBERTY AND RESTRAINT.

IN these days of unmixed adoration of liberty, we are often disposed to look upon restraint as its natural enemy, and as such to regard it with impatience and dislike. Thus there is a frequent chafing against all kinds of restraint, even the most wholesome and necessary. The youth resents the restraints of home and school; the lawbreaker those of government; some would break loose from the bonds of marriage; others, in the name of liberty, would use the press, or the mails, or the public hall, to corrupt and debase the young and ignorant. And there are not wanting those who, without any vicious desires or evil intentions, yet gravely advocate the removal of all restraints, and actually believe that such a course would reflect honor and insure benefit to mankind.

In all this there is an utter great disregard of the great truth that restraint and liberty go hand in hand in the development

of character. Indeed, without the former the latter is impossible. A recent writer pithily says: "No human being, however great or powerful, was ever so free as a fish. There is always something that he must or must not do, while the fish may do whatever he likes. All the kingdoms of the world put together are not half so large as the sea, and all the railroads and wheels that ever were or will be invented are not so easy as fins." The higher we ascend in the animal creation the more power of restraint do we see manifested, and the more honor do we instinctively pay. The horse and the dog are at once the most intelligent and the most capable of restraint of all the lower animals, and the two qualities are seldom dissociated. In human races the most barbarous and least intelligent are amenable to no restraint but that of force. They may be crushed by tyranny, or bent by the stern hand of despotism, but of wise restraint, of submission to law and order, of the government of their passions or impulses, they know as little as they do of true liberty.

As civilization advances, and as freedom becomes better understood, in that very proportion does the value of restraint become recognized. Intelligence discovers that the happiness of the community depends upon the orderly and law-abiding conduct of each citizen, and as fast as the people advance in thoughtfulness and wisdom, they become willing to submit to such restrictions as are found needful. As intelligence increases despotism declines, and as true liberty becomes better understood the necessity for certain restraints becomes recognized and admitted. The wise and wholesome restraints of parental love, of family ties, of a good government, of public opinion, and even of social observances, are the best possible preparations for that *self-restraint* which is the rock on which all true liberty is built. No slavery is so abject and humiliating as that which chains us in servile obedience to our own appetites and passions, and no power on earth can free us from such bonds except the power of self-restraint. This power, like all others, is developed by continual exercise, and he who resists or contemns all external restraints shuts himself out from this development.

The capacity of yielding to wise restraint always leads to the capacity for self-restraint. Look at the progress of the youth who has always been indulged in every whim and never thwarted in any desire. He grows up selfish and disagreeable, and though he may fancy he enjoys liberty he really knows nothing of it. For although he may bend his will to no one; though he may defy all attempts to influence him; though he may break through the barriers of public opinion, and disregard the laws of society, he yet bows in servile subjection to his inclinations, he yields the reins to his passions, he is conquered and ridden over by appetite or ambition, he has no power to guide or to control his lower nature, and thus he becomes a slave in the worst possible sense, and to the worst possible master. On the other hand the loving discipline of home, teaching the youth gradually, but steadily to curb his temper and control his desires—the wise restraints of school or college training him to habits of concentration and developing mental power—the mild laws of a good government enforcing equal rights for all her citizens—all tend to fit him to understand and to enjoy real liberty.

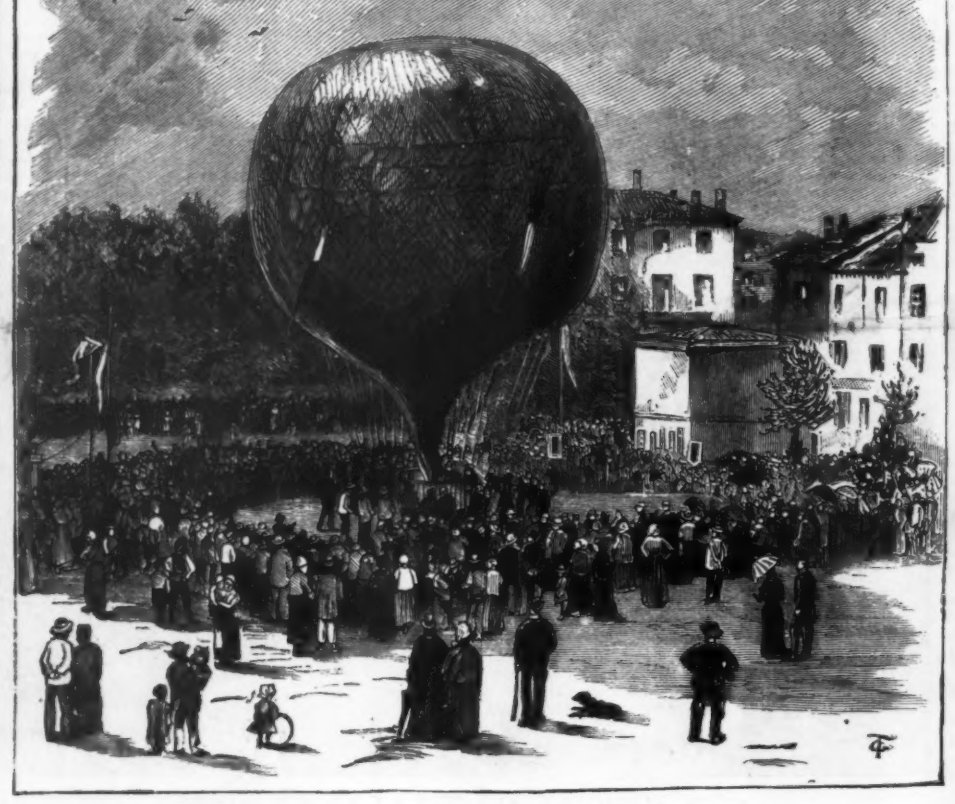
While, then, we honor freedom, and rightly work for it, let us also honor wise and just restraints, and willingly submit to them, knowing that, as the dignity and sublimity of the universe depends upon the obedience of every planet to the laws which sustain it, so our highest perfection depends upon our glad obedience to the laws which preserve and uphold society.

> "Entice the trusty Sun, if that you can,
> From his ecliptic line; beckon the Sky.
> Who lives by rule then, keeps good company."

THE MONTGOLFIER CENTENARY.

ON the 5th of June, 1783, a great crowd of the worthy citizens of Annonay met in a field outside the town, and adjoining the Carthusian Convent, in order to witness an astounding experiment, namely, the sending up into the sky of a paper structure which had been filled with smoke produced by the burning of a few bundles of straw with some handfuls of wool and a few drops of spirit—the machine to be sent up by two ingenious spirits—the Brothers Montgolfier. This commencement of the ballooning era was commemorated with considerable ceremony at Annonay, the birthplace at the Montgolfiers, on August 11, 12, 13, and 14, thanks to the exertions of a local committee, which had collected no less than 4,000*l.* by private subscriptions. The festivities were inaugurated on the 10th, by a torchlight procession, and on the next day a balloon ascent took place from the Place de Champs. In the evening there was a reception held by all the members of the Montgolfier family present at Annonay, who numbered about forty. The family are highly respected, and are mostly connected with paper-making—an industry imported into France by their ancestors, and which was exercised by the Brothers Montgolfier whose centenary they had met to commemorate. On Sunday, August 12, 1888, there was a grand costume procession, and in the evening another reception was held by M. Laurent Montgolfier in his house, close to the Vidallon paper mill, where the Montgolfier Brothers were born and

Monument erected to Joseph and Etienne Montgolfier, the first Aeronauts and Inventors of the Balloon.



The Ascent of Leon Montgolfier from the Place de Champs, April 14.

THE MONTGOLFIER CENTENARY AT ANNONAY, ARDECHE.

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GASES OCCLUDED BY COKE.

A RECENT number of the *American Chemical Journal* gives some interesting details of an exhaustive series of experiments on the gases occluded by coke, carried out by Messrs. F. H. Storer and D. H. Lewis. Reichardt's method of exhausting with mercury and heating was used, but only to compare the results given by it with those afforded by the Sprengel pump; the flask containing the coke being exhausted and subsequently heated in a paraffin bath. The first experiments were made upon some air-dried coke from the cellar of a dwelling house. The maximum temperature to which it was subjected was, as in all the other cases, 200° F. By Reichardt's method, each gramme of coke gave rather more than 1 c. c. of gas containing about 43 per cent. of carbonic acid, and 2·6 per cent. of oxygen. With the Sprengel pump, each gramme yielded about 0·7 c. c. of gas, containing 50 to 60 per cent. of carbonic acid and 2 to 6 per cent. of oxygen, as well as carbonic oxide and nitrogen. In some cases where the pump was used, a current of nitrogen was driven through the flask for some time to clear out the air more effectually. Some air-dried coke, which had been standing for two years in a dry storehouse, gave (by Reichardt's method) about the same quantity of gas as the above; the percentage of carbon dioxide being lower, and that of nitrogen and oxygen much higher. The same coke, however, with the pump gave less gas; but the percentage of carbonic acid was higher, and that of oxygen lower than in the first samples. Other experiments with old coke from out of doors, recently partially dried coke, and coke taken straight from a gas retort gave results very similar; save that, in the last case, the percentage of carbonic acid, which was at first only between 7 and 11 per cent., increased (on keeping for two months) to 21 per cent. It would thus almost seem as if a slow oxidation of the carbon had gone on. It is noteworthy that the gases given off up to 100° F. invariably contained a higher percentage of oxygen, and a lower one of carbonic acid, than those by heating to 200° F.

LADIES' SWIMMING BATH, LONDON.

OF late years, the art of swimming, which with our aquatic habits ought to be a necessary accomplishment to all, has found increasing favor with ladies, who a few years since thought that bobbing up and down in a few feet of water, while clad in the most hideous and embarrassing costume which could possibly be devised, was the height of enjoyment while bathing. Far different is it across the Channel, where, says the *London Graphic*, instead of being tied round the waist like a chained inhabitant of the Zoological Gardens, and being now and then soused by the grimmest of bathing women, ladies are wont to attire themselves in the daintiest and most becoming of costumes, to disport themselves merrily unfettered in the water, and to make up family and friendly parties for the hour of bathing. We have seen French women swim with a skill and daring which would put many an Englishman to shame. Within the last few years, however, their English sisters, always ready to take a leaf out of their book with regard to their land costumes, have begun to follow their example on the water. It is true that at present this example is mainly confined to swimming baths, but everything must have a beginning, and we will hope that it will in time spread to the sea shore. A great impetus has been given to this movement by the organization of swimming competitions. In London, at the bath where our sketches were taken, the number of competitors was at first small, but both these and the spectators—who are entirely confined to ladies—have noteworthily increased, the latter in many cases being imbued with the desire to learn and to compete themselves. The competitions are most varied in their character, as may be seen by our illustrations, and include breast swimming, the easiest and most enduring style of stroke, the dashing side stroke, swimming on the back—a pleasant change—floating, plunging, and diving—the latter for distance as well as for endurance. In addition to the fancy sports shown in our engraving, a very amusing item of the programme is "mussock" riding. Mussocks are inflated pigskins used for crossing rivers in India, and the greatest nicety in their management is required—a nicety, however, easily attained by ladies. The most important of all is the accomplishment of swimming fully dressed, which is displayed at these competitions, as well as the method of saving a fellow woman. Our illustrations are from sketches by Miss K. J. Edwards.

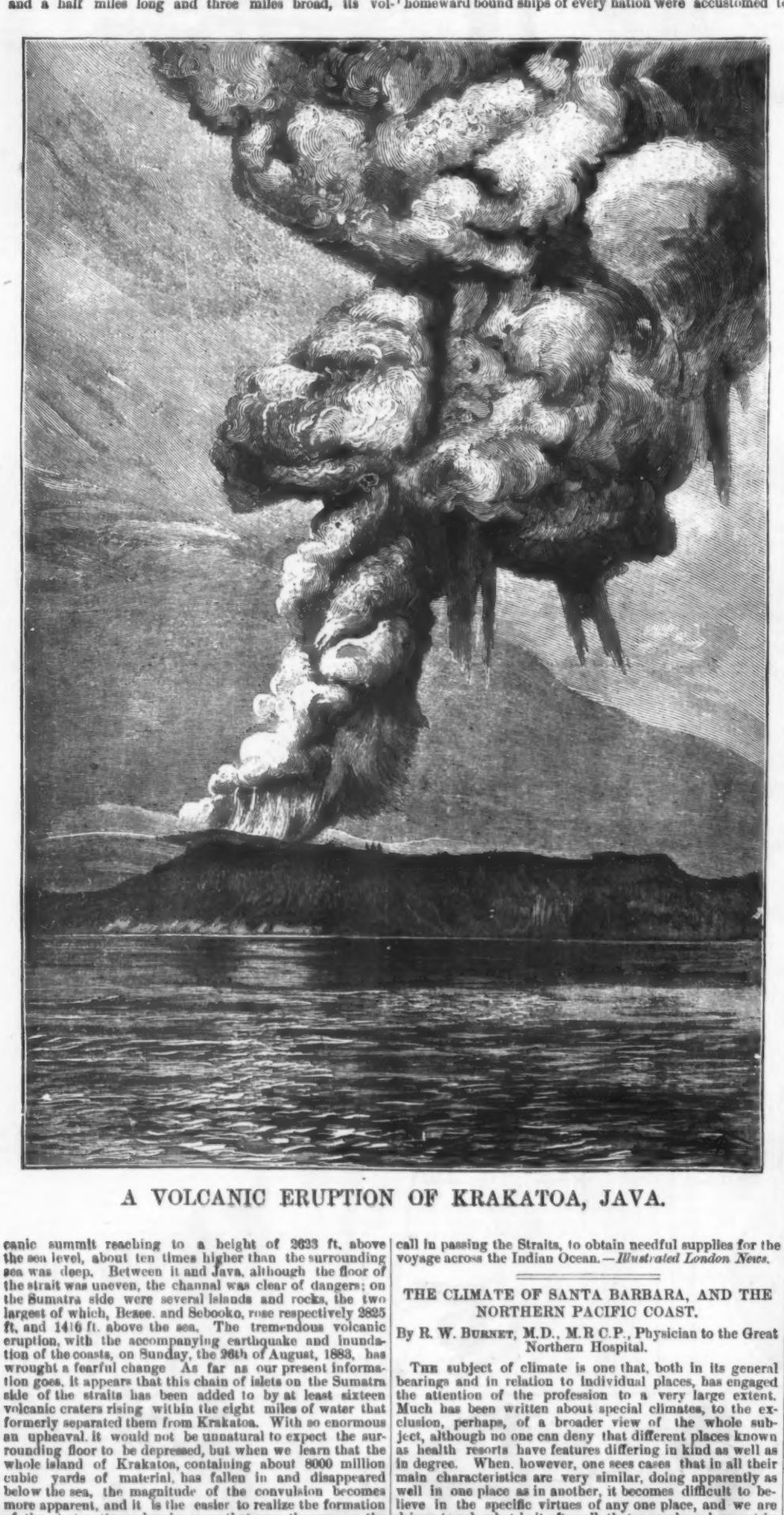
1. Some of the Costumes.—2. The Umpires.—3. The Side Stroke.—4. Preparing to Dive in Walking Costume.—5. The Tub Race.—6. A Start.—7. A General View.—8. Swimming in Walking Costume.—9. The Diver (9 Foot Jump).—10. Diving for Eggs and Pears.—11. The Distribution of Prices.—12. Blindfold and Fancy Swimming.—13. Floating Under Water.

SOME NOTES AT A LADIES' SWIMMING COMPETITION.

VOLCANIC ERUPTION IN JAVA.

THE Straits of Sunda, separating the islands of Java and Sumatra, form one of the main gateways used by the vast trade that nagivate the China Sea. All vessels bound thither from the Western Hemisphere pass either to the north or south of Sumatra, entering the Eastern Archipelago through the Straits of Singapore or else by the Straits of Sunda. Steam-vessels bound through the Suez Canal and Indian Ocean use the former route, and those rounding the Cape of Good Hope the latter. The strait is about seventy miles long, sixty miles broad at the southwest end, narrowing to thirteen miles at the northeast end. Half-way through the strait, equidistant from the two shores, was a group of three islands, the largest of which was Krakatoa, four and a half miles long and three miles broad, its volcanic summit reaching to a height of 2623 ft. above the sea level, about ten times higher than the surrounding sea was deep. Between it and Java, although the floor of the strait was uneven, the channal was clear of dangers; on the Sumatra side were several islands and rocks, the two largest of which, Bezee. and Sebooko, rose respectively 2825 ft. and 1416 ft. above the sea. The tremendous volcanic eruption, with the accompanying earthquake and inundation of the coasts, on Sunday, the 26th of August, 1883, has wrought a fearful change As far as our present information goes, it appears that this chain of islets on the Sumatra side of the straits has been added to by at least sixteen volcanic craters rising within the eight miles of water that formerly separated them from Krakatoa. With so enormous an upheaval, it would not be unnatural to expect the surrounding floor to be depressed, but when we learn that the whole island of Krakatoa, containing about 8000 million cubic yards of material, has fallen in and disappeared below the sea, the magnitude of the convulsion becomes more apparent, and it is the easier to realize the formation of the destructive volcanic wave that was thrown on the neighboring shores. We can only deplore the immense loss of life and property.

The volcanic mountain island of Krakatoa, with parts of Verlaten Island and Lang Island behind it, is shown in a sketch by Staff-Captain J. R. N. Moss, R.N. It is almost inconceivable that this island, with a mountain summit which rose nearly 2700 ft. above the level of the sea, should have been entirely submerged; but it seems to have been in the very center of the area of this vast earthquake, which convulsed the whole basin of the sea between Lampong Bay, on the south coast of Sumatra, and the opposite shores of Java, extending across a diameter of more than sixty geographical miles. The disturbance of the sea and consequent flooding of the shores, both those of Sumatra to the north and those of Java to the east of the volcanic outbreak had the most destructive effects upon the Dutch settlements at Telok Betong, at the head of the bay in Sumatra, and likewise in Java, at the well-known commercial port of Anjer, where all homeward bound ships of every nation were accustomed to call in passing the Straits, to obtain needful supplies for the voyage across the Indian Ocean.—*Illustrated London News.*



A VOLCANIC ERUPTION OF KRAKATOA, JAVA.

THE CLIMATE OF SANTA BARBARA, AND THE NORTHERN PACIFIC COAST.

By R. W. BURNET, M.D., M.R.C.P., Physician to the Great Northern Hospital.

THE subject of climate is one that, both in its general bearings and in relation to individual places, has engaged the attention of the profession to a very large extent. Much has been written about special climates, to the exclusion, perhaps, of a broader view of the whole subject, although no one can deny that different places known as health resorts have features differing in kind as well as in degree. When, however, one sees cases that in all their main characteristics are very similar, doing apparently as well in one place as in another, it becomes difficult to believe in the specific virtues of any one place, and we are driven to ask what is it after all that we seek and expect in the places to which we send patients? In the first place, I suppose we generally desire to effect as complete as possible a change in the manner and mode of life; and, secondly, to protect the patient from extremes of temperature. We seek also to place him in such circumstances as shall, especially in the case of chest affections, secure a plentiful and continually changing supply of fresh air, with a maximum amount of sunshine. Speaking in reference to consumptives, the late Dr. Parkes, whom we all recognize as an authority in such matters, said, "The best climates for phthisis are, perhaps, not necessarily the equable ones, but those which permit the greatest number of hours to be passed out of the house." The late Dr. Hughes Bennett also expressed the opinion that the climate which enabled the patient to spend the greatest part of his time in the open air was the best, and that its advantages should be considered as largely dependent on exercise, and on the stimulus given to the nutritive functions rather than its influences on the lungs directly.

The climate of a district and of a place is of course largely dependent on the physical characters of the country, the kind of soil, the relation of the mountain ranges and their height, the nearness or distance of the sea and its temperature. Thus places in very different parts of the world, but resembling one another in physical characters, may present much similarity of climate. Compare, for example, the Riviera, lying on the shores of the Mediterranean, and the Santa Barbara Valley in California, lying along the Pacific Coast. In both we have a plain, with a southern exposure, more or less sheltered from the north, northwest, and northeast by high mountains, and stretched along the shores of a comparatively warm sea. What do we find? We see that these two places, lying as they do widely apart, have not at all dissimilar climates.

The county of Santa Barbara is about seventy miles long from east to west, and thirty-five miles wide from north to south. The coast here runs for about 100 miles almost due east and west, and that part of the country lying between the Santa Ynez Mountains and the sea is called the Santa Barbara Valley. It is thus sheltered by mountains and has a southern exposure. Moreover, a chain of islands lying off the coast at a distance of some twenty miles, and rising to a height of from 2,000 to 3,000 feet, serve to protect it from ocean gales. The town of Santa Barbara lies on the shore about 285 miles southeast of San Francisco and about 100 miles northwest of Los Angeles. The whole of California was peopled by Indians up till the time of the first Spanish missions—about 100 years ago—the mission of Santa Barbara dating from 1786. It consisted of a few priests and a company of soldiers to protect them from Indian raids. Many of the present inhabitants are descendants of the soldiers of that garrison and of the early settlers who followed the establishment of the mission. The old part of the town still presents many characteristics of its Spanish origin, but its present flourishing condition is to be attributed mainly to the high repute it has gained as a sanatorium. This, in addition to a more or less fluctuating winter population, drawn chiefly from the Eastern States, has attracted many permanent residents who have made the place their home. Here you find Englishmen, Canadians, and Americans, many of whom have acquired land in the district, and have taken up, both as an occupation and as an investment, the raising of stock, and the cultivation of grain, of the orange, the olive, and the almond, all of which seem to do well. This is certainly a great advantage, especially to a young man who has to leave home for health's sake; who is sent away as a precaution, but who does not feel ill, and is not sufficiently ill to be classed with invalids. To have some out-door occupation and interest is, in such a case, more than half the cure, and this can, of course, be obtained only in a new country.

Of the climate we can speak from personal experience of only a short period in December and January, but at that season it was exceedingly pleasant: brilliant sunshine day after day, with a cloudless sky and a clear, bracing atmosphere. The rains were late, and consequently the country was somewhat brown and dry, but toward the end of the year we had a thunderstorm followed by two days of much-needed rain. The average annual rainfall is not more than sixteen or seventeen inches, and it comes chiefly in November, December, January, and February. All through the winter months roses, geraniums, verbenas, etc., flourish and bloom in the open air and without shelter, while strawberries ripen up till December, the grape ripens freely in the open, and the orange, the lemon, the Japanese persimmon, and the olive are seen in full fruit in January. The summers are dry, but not very hot, the thermometer very rarely rising to 90° F. The average temperature for July is 68°, and that for January 53° F., giving a difference of only 15° F. Snow never falls, and even slight frosts are rare. The nights are cool all the year through, but never very cold, the average difference between the warmest part of the day and the coolest part of the night being reckoned 12° F. The winter months average 54° F., the spring 60°, the summer 68°, and the autumn 63°. In his statistics of temperature and the climate of the Riviera, Dr. H. Hassall gives in round numbers the following: Winter 55°, spring 50°, summer 63°, and autumn 72°, the average for the year being a little over 60°. These figures apply chiefly to San Remo, the numbers given for Bordighera and Mentone being a little higher, and those for Nice a little lower. At the outset I alluded to the advantages of those climates that permitted the greatest numbers of hours to be spent in the open air. The following computation was made by a patient staying at Santa Barbara. During the year (Feb. 1 to Jan. 31) there were 310 pleasant days, when an invalid might be out five or six hours with safety and comfort; ten windy days and five wet ones, when he would be kept indoors all day; the remainder cloudy and showery days, on which he could be out part of the day with comfort. A feature of open air life that has been largely tried, and with the best results, at Santa Barbara is camping out. Patients living there get into the habit of being so much out of doors that the transition to camp life is easy, and has been by some carried on for four or five months continuously. In California horses are plentiful, and everybody rides. The "vacquero" spends his life in the saddle. Mere children are seen mounted on a good-sized mustang, which they manage with the ease of perfect horsemanship. Visitors buy or hire horses for the season, and the invalid, too, enjoys his morning ride. As the place has grown, so pleasant society has increased, while good shops, a club, and good hotels have rapidly sprung up.

Los Angeles, which I have already mentioned, lies a little off the coast, about a hundred miles southeast, and has a climate rather warmer and drier than Santa Barbara. It is a town of considerable size, and is the center of a large orange growing and wine making district. A hundred and twenty miles further south lies San Diego, with an annual mean temperature of 62°, and a rainfall rather under eleven inches. Going northward from Santa Barbara we have Monterey, a favorite resort

with the people of San Francisco, from which it is distant a little over a hundred miles, and is prettily situated on a bay opposite to Santa Cruz. At certain seasons San Francisco is much exposed to cold winds off the sea, and to escape these people betake themselves to Monterey, with its cedars and cypresses, and its sheltered situation. In December the climate of San Francisco was delightful, far more pleasant than in September, being moderately warm and equable. In summer the early part of the day was often very hot, but toward noon a cold wind would sweep inward off the sea with chilling and penetrating force. Passing to the northward of San Francisco, we have, in Western Oregon and in Washington Territory, a lower temperature and a long, wet winter, with a rainfall of as much as forty-five inches or more. This district lies to the west of the Cascade range of mountains, and extends as far north as Puget Sound. Immediately to the north of this are the Straits of San Juan de Fuca, separating British from American territory. On the northern shores of the straits, at the southeast corner of Vancouver Island, the town of Victoria, capital of British Columbia, is picturesquely situated.

It is surprising, at first sight at least, to find, nearly a thousand miles north of San Francisco, a climate closely resembling that of the English south coast, having a winter average temperature of 43° F., and a summer of a little over 60°. This mildness, which extends more than three hundred miles north of Victoria, is attributed to a warm stream called the Japanese current, which strikes the Queen Charlotte Islands and flows southerly along the shores of Vancouver Island. Victoria bids fair to become a favorite winter residence and sanatorium, for in addition to the beauty of its surroundings, the fact that it has such a mild and equable climate will, especially when the railway now in process of construction over the Rocky Mountains and through the magnificent cañons of the Fraser River is completed, attract many inhabitants of the cold Northwest to take refuge on its sunny shores.

In conclusion, I would only remark that while this Pacific coast, with its unsurpassed beauty of scenery and attractions of climate, is by distance and difficulty of travel shut off from many classes of invalids, to those who have to seek an early and permanent residence abroad it undoubtedly presents many advantages.—*Lancet.*

Wimpole Street, W.

THE THERAPEUTICAL DRINKING OF HOT WATER; ITS ORIGIN AND USE.

By EPHRAIM CUTTER, M.D., New York.

THE therapeutical drinking of water at a temperature of blood heat to 150° F. having become popular enough to call for an allusion to it in *The Lancet*, as a valuable American contribution to medicine, and since it seems to be used at random from the directions of its distinguished introducer, I have thought that the origin and proper use of hot water should become history. The practice dates back to 1858, when Dr. James H. Salisbury of this city concluded a series of experiments on feeding animals to ascertain the relations of food as a cause and cure of disease. Besides swine, he experimented on men. These he took in companies of six healthy laborers, placed under military discipline, which he enforced himself. He also ate and drank as they did. The men were kept on single articles of food, coffee, and water. Among these articles were beans, beef, bread, chicken, crackers, fish, lobster, mutton, potatoes, rice, turkey, oatmeal. The blood, urine, and fæces of the animals were carefully examined microscopically and chemically daily without any preconceived idea to develop, but simply to ascertain facts and develop ideas from those facts. In this manner he went through the whole range of food to show the permanent value when lived on exclusively and singly. Among other things, he found that the fermentations of food, and the products of these fermentations, were the chief primary factors in producing the diseases which arise from unhealthy alimentation. With the idea of removing these diseases by removing their causes, he employed hot water in order to wash out the saccharic, acetic, butyric, hydrosulphuric, and lactic acids, and sulphide of ammonium fermentation-vegetations (yeasts) from the stomach and intestines. At first he tried cold water on his men to remove these products of fermentation, but the cold water caused distress, pain, and colic, so he increased the temperature of the water. Lukewarm water made them sick at the stomach, and excited peristalsis upward. The temperature of the water was increased to hot—110° to 150°. This was well borne, and afforded a feeling of agreeable relief, which thousands since testify to. The hot water excites normal downward peristalsis of the alimentary canal, washes down the slime, yeast, and bile through its normal channels, washes out the liver and kidneys, and the bile is eliminated through the bowels, and not through the blood *via* the kidneys. It was some time before the proper times of administration, and proper number of ounces of hot water, and the proper number of ounces to be drunk at meals could be settled in order to obtain the best results. These directions may be found published in connection with the Salisbury plans for the treatment of consumption, Bright's disease, diabetes, fibroids, sclerosis, and colloid diseases. At the risk of repetition, and for the sake of a more thorough understanding of the subject, these details will be plainly and simply given.

1. *Directions for using Hot Water according to the Salisbury Plans.*—The water must be hot, not cold or lukewarm. By hot water is meant a temperature of 110° to 150° F., such as is commonly liked in the use of tea and coffee. This is to excite downward peristalsis of the alimentary canal. Cold water depresses, as it requires animal heat to bring it up to the temperature of the economy, and there is also a loss of nerve force in this proceeding. Lukewarm water excites upward peristalsis or vomiting, as is well known. In cases of diarrhœa the hotter the better. In cases of hæmorrhages the temperature should be at a blood heat. Ice water is disallowed in all cases, sick or well.

2. *Quantity of Hot Water at a Draught.*—Dr. Salisbury first began with one-half pint of hot water, but he found it was not enough to wash out, nor to bear another test founded on the physiological fact that the urine of a healthy babe sucking at the breasts of a healthy mother, the best standard of health, stands at sp. gr. varying from 1015 to 1020. The urine of the patient should be made to conform to this standard, and the daily use of the urinometer tells whether the patient drinks enough or too much hot water. For example, if the sp. gr. of the urine stands at 1030, more hot water should be drunk, unless there is a loss by sweating. On the other hand, should sp. gr. fall to 1010, less hot water should be drunk. The quantity of hot water varies usually from half to one pint, or one pint and a half at one drinking. The urine to be tested should be the urina sanguinis, or that voided just after rising from bed in the morning, before any meals or drinks are taken. The quantity of urine voided in twenty-four hours should measure from forty-eight to sixty-four ounces. The amount will of course vary somewhat with the temperature of the atmosphere, exercise, sweating, etc., but the hot water must be given so as to keep the specific gravity to the infant's standard—to wit, 1015–1020. The urinometer will detect at once whether the proper amount of hot water has been drunk, no matter whether the patient is present or absent. Another test is that of odor. The urine should be devoid of the rank urinous smell, so well known but indescribable. It should be like the babe's urine, free from odor and deposit on cooling, and the color like that of champagne. The Salisbury plans aim for this in all cases, and when the patients are true and faithful the aim is realized.

3. *Times of taking Hot Water.*—One hour to two hours before each meal, and half an hour before retiring to bed. At first Dr. Salisbury tried the time of half an hour before meals, but this was apt to be followed by vomiting. One hour to two hours allows the hot water time enough to get out of the stomach before the food enters or sleep comes, and thus avoids vomiting. Four times a day gives an amount of hot water sufficient to bring the urine to the right specific gravity, quantity, color, odor, and freedom from deposit on cooling. If the patient leaves out one dose of hot water during an astronomical day, the omission will show in the increased specific gravity, as indicated by the urinometer, in the color, etc. Should the patient be thirsty between meals, hot water can be taken any time between two hours after a meal and one hour before the next meal. This is to avoid diluting the food in the stomach with water.

4. *Mode of taking the Hot Water.*—In drinking the hot water it should be sipped, and not drunk so fast as to distend the stomach and make it feel uncomfortable. From fifteen to thirty minutes may be consumed during the drinking of the hot water.

5. *Length of time to continue the Use of Hot Water.*—A period of six months is generally required to wash out the liver and intestines thoroughly. As it promotes health, the procedure can be practiced by people in health throughout life, and the benefits of cleanliness inside be enjoyed. The drag and friction on human existence from the effects of fermentation, foulness, and indigestible food, when removed, give life a wonderful elasticity and buoyancy, like that of the babe above alluded to.

6. *Additions to Hot Water.*—In case it is desired to make it palatable, and medicate the hot water, aromatic spirits of ammonia, clover blossoms, ginger, lemon juice, sage, salt or sulphate of magnesia are sometimes added. Where there are intense thirst and dryness, a pinch of chloride of calcium or nitrate of potash may be added to allay the thirst and leave a moistened film over the parched and dry mucous membrane surfaces. When there is diarrhœa, cinnamon, ginger, and pepper may be boiled in the hot water, and the quantity lessened. For constipation a teaspoonful of sulphate of magnesia, or half a teaspoonful of taraxacum may be used in the hot water.

7. *Amount of Liquid to be drunk at a Meal.*—Not more than eight ounces. This is in order not to unduly dilute the gastric juice or wash it out prematurely, and thus interfere with the digestive processes.

8. *The Effects of Drinking of Hot Water as indicated are:* The improved feelings of the patient. The fæces become black with bile washed down its normal channel. This blackness of fæces lasts for more than six months, but the intolerable fetid odor of ordinary fæces is abated, and the smell approximates the odor of the fæces of healthy infants sucking at healthy breasts; and this shows that the ordinary nuisance of fetid fæces is due to a want of a proper washing out and cleansing of the alimentary canal from its fermenting contents. The urine is as clear as champagne, free from deposit on cooling or odor, 1,015 to 1,020 sp. gr., like an infant's urine. The sweat starts freely after drinking, giving a true bath from the center of the body to the periphery. The skin becomes healthy in feel and appearance. The digestion is correspondingly improved, and with this improvement comes a better working of the machine. All thirst and dry mucous membrane disappear in a few days, and a moist condition of the mucous membrane and skin takes place. Ice water in hot weather is not craved; and those who have drunk ice water freely are cured of the propensity. Inebriety has a deadly foe in this use of hot water.

9. *Summary of General Considerations on the Therapeutical Drinking of Hot Water.*—(*a*) Foundation for all treatment of chronic diseases. (*b*) Excites downward peristalsis. (*c*) Relieves spasm or colic of the bowels by applying the relaxing influence of heat inside the alimentary canal, just as heat applied outside the abdomen relieves. (*d*) Dilutes the ropy secretions of the whole body, and renders them less adhesive, sticky, and tenacious. (*e*) Inside bath. (*f*) Dissolves the abnormal crystalline substances that may be in the blood and urine. (*g*) Necessary to have the hot water out of the stomach before meals. (*h*) Its use is to wash down the bile, slime, yeast, and waste, and have the stomach fresh and clean for eating. (*i*) Promotes elimination everywhere. (*j*) If objection is made, it must be remembered that we are seventy-five per cent. water. (*k*) The gas that sometimes eructates after drinking hot water is not formed by the hot water, but was present before, and the contractions of peristalsis eject it, or sometimes it is the air that is swallowed in sipping, as horses suck air. The amount of gas contained in the alimentary canal is larger than most are aware of, and yet it is not excessive, as it takes some time to eruct a gallon of gas from the stomach. This time can be tested by submerging a gallon jug filled with air under water and observing how long it will be in filling with water. (*l*) Some physicians have advised against hot water on the ground that it would burn the covering off the stomach. If this is so, then a denudation of the lining of the stomach for twenty-five years is compatible with a state of otherwise perfect health with no sign of illness for that period of time, and is also compatible with the numerous cures that have occurred under the use of hot water as a foundation during the past twenty-five years. Again, the same physicians drink tea and coffee at the same temperatures, and this act belies their warning and shows their inconsistence and want of consideration before speaking. (*m*) These dicta about the therapeutical drinking of hot water were founded on physiological experiments at the outset, verified in pathology and based on the experience derived from the treatment of thousands of cases since 1858.

Personal Estimate of the Founder of this Practice.—"If I were confined to one means of medication, I would take hot water." It may be added that he has drunk hot water for twenty-five years.

Corroboration of the Writer.—The writer testifies that his own personal experience and observation corroborate the truth of these statements of the Salisbury plan.—*London Lancet.*

New York, 1883.

KAIRINE—THE LATEST RIVAL OF QUININE.

THIS new antipyretic agent has as yet attracted but little notice in this country, although it has for some time been the subject of investigations by our German confrères. It was discovered about a year ago by Dr. Fisher, of Munich, who states that it is the hydrochloride of oxyethylquinoline-hydrid. If there is anything in a name, there ought to be no doubt of the value of the remedy, but this is a busy world, and life is short, so the name has been mercifully changed to kairine. The testimony thus far collected, concerning the properties of kairine, is somewhat conflicting. Dr. Girat has experimented largely with it on animals, and has found its lowering effects upon temperature to be very constant. It also slows the pulse and diminishes the number of respirations. He administered the drug hypodermically, and states that the member into which the injection was passed became paralyzed. The sensibility of the part was blunted, passing sometimes to complete anæsthesia. Elimination occurs, in part at least, by the kidneys, and is tolerably rapid, the presence of the substance in the urine being determined within twenty-five minutes after its administration. The urine acquires a dark green color. According to Dr. Girat's experiments, the toxic dose is said to range between one and two grains to the pound of the weight of the animal. Dr. Filehne (*Berliner Klinische Wochenschrift*, April 21, 1883) concludes, from observations made by him in disease, that kairine is a most valuable febrifuge, effective in all conditions accompanied by elevated temperature. He has employed it with success in typhoid fever, acute articular rheumatism, septicæmia, phthisis, and pneumonia. He recommends its use tentatively in commencing doses of seven and a half grains per hour for four hours, or until the temperature has fallen to 100° F. The dose is then lowered to three or four grains, to be again increased when the temperature begins to rise. It is stated that by carefully experimenting during the first day, the proper dose may be ascertained for each individual, which may then be adhered to in the subsequent treatment. These favorable effects have not been recorded, however, by all observers. Professor Riegel reports most unsatisfactory results in the treatment of pneumonia by kairine (*Allgemeine Medicinische Central-Zeitung*, July 28, 1883). He was unable to obtain any notable reduction of temperature by four hourly doses of seven and a half grains each, and even larger amounts were often powerless to produce the desired effect. Even when he succeeded in reducing the temperature nearly to the normal, it often rose again in spite of repeated doses of the remedy. As regards the pulse, it was by no means reduced in frequency as the temperature fell, and, furthermore, it was much weakened. An improvement in the subjective sensations of the patient, as described by Filehne, was not met with, but, on the contrary, there was repeatedly observed such a depression, amounting almost to collapse, that it was necessary to discontinue the kairine and resort to stimulants. The same effect has been noticed by Seifert. Professor Riegel concludes that kairine is a dangerous remedy, in pneumonia at least, chiefly because of its depressing action upon the heart, and he cautions against its use in asthenic forms of the disease. It is evident that further trials are necessary before the exact value of this new substitute for quinine can be determined, and it is doubtful whether it will be able to maintain the high character as a safe and certain antipyretic which the early experimenters claimed for it. In fact, few new remedies answer fully to the expectations of their introducers.—*Med. Record.*

PASSIFLORAS AND THEIR CULTURE.

PASSIFLORAS constitute a large family of evergreen climbers, mostly of strong growth, especially such as are strictly stove species. Many of them are only adapted for comparatively large structures; if introduced to small houses it becomes necessary to use the knife to such an extent that little of their true habit and disposition to flower is possible, while, on the other hand, if allowed to ramble in a way to exhibit their natural character, they all but smother everything else, and, however desirable it may be to see such plants developed to their full extent, it is going further than most people will care when a whole house or division in a range is almost given up to a single plant or two. Where, however, there is sufficient room, they rank among the grandest of climbing or twining plants. Their cultivation is very easy, as they are generally indifferent to the description of soil their roots are placed in, provided it is not too adhesive or too poor; in the former case, from the quantity of water required to develop and maintain their large amount of leaf surface, it would become sour and unkindly; and if too poor, the foliage always looks sickly, and is liable to be infested with insects, which are usually persistent in their attacks on plants not in a free condition of growth. But in avoiding this, the opposite mistake must not be committed of using the soil in too rich a state, as in this case the plants grow so rampant as to be unmanageable; if a little manurial assistance becomes necessary, it can be supplied in a liquid state. The Passion flowers are botanically nearly allied to the Tacsonias; the species here treated of require considerable heat to grow them, being natives of hot countries, such as the warmest parts of Mexico, Brazil, Jamaica, and other West Indian islands. One of—if not the very finest—of the group, P. quadrangularis, is from Jamaica; it has ample, deep green, handsome foliage, and very large beautiful flowers, singular alike as the rest of the family in their very strange formation, as well as in the effect produced by their combination of blue, red, and green; in P. Buonapartea, sometimes grown under the name of the former species, the color is red, blue, and white.

Propagation.—They strike readily from cuttings made of the young shoots taken off with a heel during the spring or summer, when they have attained a length of 5 inches or 6 inches. Insert them singly in small pots drained and half filled with sandy peat, the remainder sand alone; keep them moist and confined under a bell-glass or in a propagating frame with or without bottom heat. They will root in the course of a few weeks, when the glass may be dispensed with; as soon as the small pots are moderately filled with roots, shift into larger ones. From their free habit of growth, they will bear a larger shift than most things. Six-inch or 7-inch pots will not be too big, placing a stick to support each plant. They will stand a strong heat when there is sufficient length of daylight to warrant its application. 70° to 75° in the night, with a proportionate rise by day, will not be too much, though they will grow, but comparatively slower, with less. Keep them well up to the glass, where all the light possible will reach them, using a

thin shade during the middle of the day, but not more than is found necessary to prevent the leaves scorching; give air daily more or less according to the state of the weather, syringe freely overhead at the time of closing the house, but not oftener even in the hottest weather, for when carried beyond this it is a practice which I may here allude to as highly injurious to all but a very few exceptionally moisture-requiring subjects; it excites undue growth at the expense of substance and solidity in both the leaves and shoots. Stopping of the single shoots, that each will be so far be composed of, must needs be regulated by the purpose the plants are wanted for; if to cover an end wall in a span-roofed house, or to occupy several rafters in the roof, it will be necessary to pinch out the point of the shoot once or more, so as to induce the production of several growths to fill the space required; but if to be grown as these plants sometimes are, where space is limited, lengthways of the house, over a path where one or two branches are trained to wires as near the glass as the rafters will permit, they will only require stopping so far as to furnish the few growths needed. In this way they will flower freely, but have not so nice an appearance as when occupying a position where the blooming shoots can hang down in a looser manner. By July another shift will be required; 12-inch pots by this time will not be over large, and as soon as the shoots have attained sufficient length the plants may be put in the positions they are intended permanently to occupy. If to be

Planted out, the border in which the roots are to be placed should not be too large, or it will be difficult to keep the plants within bounds. The bottom must be well drained, with the requisite egress below for the water to get away. This is a matter that frequently does not receive sufficient attention, from a supposition that the surplus water that soaks through the soil in the process of watering will find its way off; yet such is by no means the case, as after a time the under surface gets almost impervious to water, and the roots, which, with free-growing plants like these Passifloras, are produced in quantity, and lie thickly in the bottom of the pot, tub, or border in which they are grown, as a natural consequence, if stagnant water exists there, rot, causing the unhealthy condition the plants are often seen in. From 9 inches to 10 inches depth of soil will be enough for the roots to ramble in, using it moderately rich, and containing enough sand to keep it quite porous. The shoots will require constant attention until they have filled the space they are destined to cover, keeping them trained to the supporting wires, and taking care that the lower portion is sufficiently clothed first, or it will be difficult to accomplish this afterward without cutting the plants back, and beginning the work anew by inducing the production of a fresh lot of shoots to cover the space that in the first instance they should have been trained over. It should ever be borne in mind in the cultivation of these climbing plants, as also of such as are of a twining habit, that they have the greatest disinclination to extend downward except in the case of the flowering terminal shoots which often are found in a hanging position; but the strong growths made early in the season, require, at the least, to be kept in a horizontal position, and do still better where they can ascend. So apparent is this, that it may be noticed where a strong shoot happens to lose its hold of the support to which it was clinging, and thus hangs with its point downward, that it makes little progress afterward, generally breaking out another growth at the highest point where bent, leaving the pendent portion in a half starved, dwindling condition. Were more notice taken of the habit of climbing and twining plants, and their natural requirements kept before the eye of the cultivator, there would be much fewer failures with them. After the plants have filled the position allotted to them, little more training will be required than a regulation of the shoots, so as to prevent their getting entangled in masses, cutting in yearly after the season's growth and flowering are completed. When there is an apparent exhaustion of the soil, it will be best to meet this in two ways by removing a few inches of the surface in spring before growth commences, replacing it with good new material, and also by the use of manure water, which the plants will take in a somewhat stronger state than weaker growing subjects; by these means they will keep on in a healthy condition for many years. When the roots of Passifloras are confined to pots or tubs, it is necessary that these should be large, and that as much of the surface soil as can be should annually be removed and replaced with new, well enriched with rotten manure; this, with the help of manure water given regularly through the growing season, will keep them in a thriving state for three or four years, when they may be headed back, and after they have broken into growth partially shaken out and the soil renewed. This will impart to them the requisite vigor to grow and bloom for a few more years, when the operation may be repeated, or their places supplied by young plants which, from their freedom to strike and grow, there is little difficulty in getting up to a large size in a short time. The most suitable kinds for general cultivation are:

P. quadrangularis.—A strong growing kind, with broad, massive green leaves, and blue, green, and red flowers. Jamaica.

P. quadrangularis aucubafolia.—A variegated leaved form of the above with handsomely marked foliage.

P. Buonapartea.—A strong growing, large leaved kind, with blue, white, and red flowers.

P. amabilis.—A free-growing, handsome variety from South America, bearing scarlet and white flowers.

P. kermesina.—This is a handsome kind that branches freely, and produces its crimson flowers in abundance.

P. princeps.—A handsome, moderately vigorous kind with scarlet flowers.

P. Decaisneana.—A fine free growing kind.

P. alata.—A handsome free-growing sort, with blue and red flowers. West Indies.

P. cardinalis.—A very handsome kind, with bright effective flowers produced freely. Suitable for a large house.

P. fulgens (Tacsonia Buchanani).—A strong growing handsome plant, with bright scarlet flowers.

P. Loudoni.—A moderate grower, bearing handsome purple flowers, produced freely.

P. edulis.—This is a strong growing sort, with white flowers, in addition to which it bears edible fruit. West Indies.

Insects.—Passifloras are not more particularly subject to insects than the generality of heat-requiring plants, yet where these parasites exist they will live on them, especially mealy bug, which must be sought for at the base of the leaves and in the crevices of the bark on the mature stems and half ripened shoots; also, the syringe can be freely employed, which will be a means of keeping them under, still further aided by strong washings with insecticide when the plants are at rest. Scale removed by sponging, and should thrips or red spider make their appearance a free use of the syringe will be the best remedy.—*T. B., in The Garden.*

REASONING POWERS IN THE CAT.

MY brother-in-law, Mr. Benjamin Hall, had a large emasculated cat which showed some characteristics which may be worthy of record.

He was much attached to his master and followed him in his walks about the fields after the manner of a dog. On one occasion he was thus conducted to a considerable distance from the house into the prairie, where a considerable number of the spotted prairie gopher had colonized, invited, no doubt, by the favorable condition of the soil for their burrows. The cat soon captured one of these, which he brought to his master, whose caresses and commendations seemed to be highly gratifying to him. The cat then made a breakfast of his capture.

Very frequently after that the cat would resort to this favorite hunting ground, but would never eat his game on the spot, but would bring it home and exhibit it in triumph, and, after being duly caressed, would quietly go to some convenient, retired place, and make his meal.

But all this shows strong attachment and a love of approbation in a high degree.

On another occasion this cat showed a much higher degree of intellectual endowment. One day he followed his master among some trees On the outer end of a bough a young robin was observed about twelve feet from the ground. The bird was soon observed by the cat, who deliberately surveyed the situation for a few minutes and then stealthily repaired to the foot of the tree and began to ascend it on the side opposite the bird, completely concealing himself from the bird till he reached a large limb which projected out over the bird. Slowly and cautiously he crept along the upper side of this limb till nearly over the bird, when he gave a spring, caught the bird in his flight, and lit upon the ground and ran away with his prize. He had been often reproved for catching birds; so, as if conscious he had done wrong, he did not present himself for commendation as he did when he had caught a gopher. Plainly he had learned something of the principles of right and wrong. In the capture of the bird he executed a deliberately formed plan, which manifested a very considerable degree of reasoning powers beyond that of inherited habit.—*J. D. Caton.*

[PROCEEDINGS OF UNITED STATES NATIONAL MUSEUM.]

LUCILIA MACELLARIA INFESTING MAN.

By FRED. HUMBERT, M.D., F.C.S.

I SEND you herewith a gag or screw fly (?) as known here; they are in alcohol, or alive in a green bottle; some of the maggots are also in alcohol. I wish you would hand this species to your entomologist for a minute examination and its proper name, as I cannot find a full description of this insect and its habits in any books in my possession. The following is part of an essay penned in 1876 but not published, which, with the history of this fly, will explain itself:

A farmer's wife, thirty-five years of age, was attacked on Monday, September 27, 1875, with a headache and a flushed face. She staid at work, expecting a malarial chill, an affection prevailing at that time in the neighborhood. From this time the pains in the region of the frontal cavity at the base of the nose and below the eye, extending to the right ear, increased. At times the pain was more severe than at others, but is never entirely lost. This pain was described as preventing hearing and breathing, and so excruciating that at intervals, day and night, her cries could be heard at a great distance from the house. Tuesday evening blood mucus began to run from the right nostril, which was somewhat swollen, the swelling extending on Tuesday over the whole right side of the face. On this day, the fifth of the complaint, four large maggots dropped out of the right nostril. When I was first called to the patient, Monday, October 4, only the right lip and nostril were swollen, the acrid discharge having somewhat blistered the lips below. After each discharge the maggot dropped from the nostril, until the twelfth day, one hundred and forty or more maggots having escaped. The majority of the maggots were three-quarters of an inch in length, there being only a few which seemed a line or two shorter; they were of a yellow hue, conical shape, and having attached to one end two horn-like hooks. The patient recovered fully.

Monday, September 18, 1882, I saw a patient, in the same neighborhood as the first, suffering from the same malady. At that time two hundred and eighty maggots had been discharged, and at the close of the illness over three hundred. There was a swelling on each side of the nose, with a small opening to each. I lanced these openings and more maggots came out.

In the Indian Territory the so-called screw fly laid its eggs in the nose of man. In 1847 I heard of several deaths of men and children in Texas, near Dallas. The gad fly was common in the American Bottom forty years ago. It laid its eggs in the noses of cattle and in the ears of horses and deer, but never in the human nose. The fly that I send is about four times as large as the common fly. Head a dark, glistening green; a bronze face, very lively in appearance. Is it the same that they called in Texas or Indian Territory the screw fly, or is it the gad fly seeking a new field?

The patient of 1875 is now alive and well. The second case occurred two years ago near Collinsville, in this county, and proved fatal. The third patient, above named, is getting well. The fourth is reported from Georgia; the patient died.

The first case which I had under my charge was the first which ever occurred here. The eggs must have been deposited in the nose several days before the fifth, the day the maggots dropped out. On the eleventh day all were discharged. I secured live maggots at that time, September 18, 1882. I put soil in an open mouthed vial and dropped the maggots on it; they crawled in the ground in about five minutes. I covered the opening with white damastis and hoped that the next year the fly would come out of the ground. But on October 6, or the twentieth day, the vial had fourteen living flies. So, reckoning from six days before the pain commenced for the laying of the eggs, to the twelfth day, when the maggot discharged, making eighteen days, and to this adding the twenty days during which the grubs were in the ground, we have thirty-eight days from the time the fly laid the egg until a new generation of flies is produced from them.

You may think I have dwelt too long on these cases, but if you had to stand at the bed and had seen the suffering and despair of the patients and found that the worms were eating them up, you would not think so.

Respectfully,

FRED. HUMBERT, M.D., F.C.S.

Alton, Ill., October 7, 1883.

P.S.—All these cases occurred in the month of September.

REPORT BY C. V. RILEY.

Prof. Spencer F. Baird, Secretary Smithsonian Institution.

SIR: The insect referred to in the accompanying communication from Dr. Fred. Humbert, of Alton, Ill., is the *Lucilia macellaria* of Fabricius, the injuries of which to different animals are well known in the South and West, where the larva is called the "screw worm." I have repeatedly endeavored to obtain the true parent of this worm, and have published in reference to it in the *American Entomologist*, 1880, pp. 21, 203, and 275. Dr. Humbert's communication is most interesting, but the specimens yet more so, as the flies he forwards are the first that have positively been bred from the larvæ known as "screw worms," and they confirm the above determination of the species. The larvæ agree with others which I have from Texas, taken from the root of the ear of a hog which had been bitten by a dog. In De Bow's "Industrial Resources of the Southern States," vol. i., is an account of its occurrence in remarkable numbers in the Southern States in 1834.

It is an interesting fact concerning this insect that it also occurs in the Eastern and Middle States, but that in these States we rarely hear of its injuries to man or to domestic animals.

Carbolic soap is considered an excellent preventive in the Southwest, and, according to Prof. J. Parish Stelle, who made the experiment for me in 1880, pyrethrum blown upon the sores will induce the worms to issue forth and leave them.

Respectfully,

C. V. RILEY, Curator of Insects.

Smithsonian Institution, Washington, D. C., Nov. 9, 1882.

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TABLE OF CONTENTS.

PAGE

I. CHEMISTRY AND METALLURGY.—Determination of Iron. By J. KRUTWIG and ALB. COCHETEUX.... 6475
Hardening Soft Limestones with Fluosilicates.... 6475

II. ENGINEERING AND MECHANICS.—Experiments on Plated Forts at Shoeburyness.—With three engravings, showing formation of wall tested.... 6473
Large Plate Shearing Machine.—With description and engraving.... 6477
Improved Automatic Lathe.—3 engravings.... 6477

III. TECHNOLOGY.—Explosive Compounds.—An address delivered before the Society of Chemical Industry by Sir FREDERICK ABEL.—Treating of blasting powders.—Powder without sulphur.—Gun-cotton.—Modern projectiles and powder charges.—Heat and gases of powder.... 6472
Permanent Silver Printing. By GEO. BRUCE.—Giving process used in making silver prints on collodiochloride of silver paper.... 6474
Perfumes and Essential Oils.—A new mode of extraction by means of vacuum and cold. By LAURENT NAUDIN.—With engraving of apparatus used.... 6480

IV. ELECTRICITY, LIGHT, ETC.—Testu's Telephone.—2 figures.... 6479
Moses's System of Telephone Transmission by a Single Wire.—With full description and 3 figures.... 6480
Lippen's Telephone.—2 figures.... 6481
Kaiath's System of Lighting Railroad Coaches by Electricity.—Full description of lamp and charging station.—2 figures.... 6480

V. NATURAL HISTORY.—On the Properties of Water and Ice.—Ingredients of the water of the Arctic Ocean.—The change of heat and volume by freezing of different kinds of water.—Heat developed by the freezing of sea water inferior to that of pure water.—To what does sea water ice owe its salinity.... 6482
Volcanic Eruption in Java.—With engraving.... 6484
The Climate of Santa Barbara and the Northern Pacific Coast. By Dr. R. W. BURNETT.... 6484
Reasoning Powers in the Cat.... 6486
Lucilia Marcellaria Infesting Man.... 6486

VI. AGRICULTURE AND HORTICULTURE.—A Crop of Seven Millions of Cotton Bales.... 6473
Passifloras and their Culture.—Propagation.—Planting.—Different varieties.—Insects.... 6485

VII. ART.—The German National Monument on the Niederwald, opposite Bingen on the Rhine.—2 engravings.... 6472

VIII. MEDICINE AND HYGIENE.—The Therapeutical Drinking of Hot Water; its Origin and Use. By Dr. EPHRAIM CUTTER.... 6485
Kairine.—The latest rival of quinine.... 6485

IX. MISCELLANEOUS.—Science in Antiquity.—The machinery of the temples.—With 3 engravings.... 6482
The Transvaal Gold Law.—A resume of its provisions.... 6485
A Heroine of Tel-el-Kebir.—The regimental dog "Juno."—With engraving.... 6485
Liberty and Restraint.... 6485
The Montgolfier Centenary.—With engravings showing monument erected to Joseph and Etienne Montgolfier, and the ascent of Leon Montgolfier.... 6485
Ladies' Swimming Bath, London.—With full page of engravings.... 6480

X. BIOGRAPHY.—Sir Robert Rawlinson, C.B. With portrait.... 6472

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